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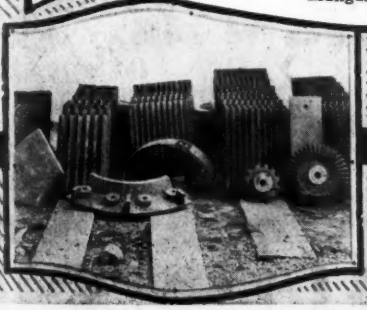

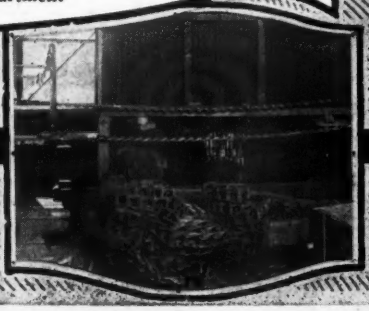

December, 1923

Index to Advertisers - - - - - - Page 57
Table of Contents - - - - - - - Page 59

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MATERIAL HANDLING MACHINERY

Pit and Quarry

Member Audit Bureau of Circulations
A Monthly Journal for Producers of Sand, Gravel, Stone, Cement, Gypsum and Lime

VOL. 8 CHICAGO, ILL., DECEMBER, 1923 NO. 3

TABLE OF CONTENTS

Paint During Winter..... 61
Portland Cement Sets New Record in October..... 62
William Taylor Passes Away 62
What Do You Expect of Your Crane?..... 64
Another Wet Mortar Plant..... 67
Harvesting Plant for Sand and Gravel Pit..... 71
The Clamshell Bucket in Excavation..... 74
The Dragline Excavator for the Gravel Plant..... 76
Selection of Excavating Equipment..... 81
Gelatin Dynamite in Quarrying..... 83
Cheaper and Simpler Crushing Plants..... 85
Power Selection in Pits and Quarries..... 90
Electric Locomotives for Pit and Quarry..... 92
Hammer and Single Roll Crushers..... 95
Economical Transportation in Pit and Quarry..... 98
Shovel Economies in Quarry Work.....100
Application of Air Separation.....103
Electrification for Pits and Quarries.....104
Cableways in Quarrying.....106
Stripping Methods at Pits and Quarries.....108
The Storage of Material 111
Multiple-Feed Lubrication with Grease.....117
Gasoline Shovel Applications.....119
Compressed Air in Pit and Quarry.....120
Electricity in the Quarry.....121
Progress in Rock Drilling.....124

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No. 1 & 2 — Loading trucks from storage piles with a Barber-Greene, which displaced a 10-yard crane on this service in the yards of the Lake Shore Stone Company, Milwaukee.

No. 3—A Barber-Greene which provides a flexible loading system for the Pipkorn-Marggraff Company. Only one man is required for loading a truck with 5 yards in 3 minutes.

No. 4—A Barber-Greene in the plant of the Continental Products Co. Calendonia, N. Y.

Their Barber-Greene has replaced their 10-ton crane for loading trucks

Early in the year the Lake Shore Stone Company of Milwaukee purchased a 10-ton crane for *un*loading cars and *loading* trucks.

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Because of the all-round better performance of the Barber-Greene on the truck loading part of the job, it was decided to quit using the crane for this work and to do it all with the Barber-Greene.

The crane was used entirely for unloading cars, and because it was freed from unloading duty it saved much in demurrage charges that would otherwise have been incurred.

Through the better unloading effected by the released crane and the better loading of the Barber-Greene the Lake Shore Stone Company was enabled to fill all its orders promptly—and that also meant money.

This company's use of the Barber-Greene in combination with other equipment is one of the many illustrations of the use of Barber-Greenes in handling building material of all kinds.

For additional information send for our rock, sand and gravel handling literature.

Please note also that the base price of the Barber-Greene U-Type Conveyor is now $350. Send for additional information and for prices covering electric and gas engine equipment.

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Pit and Quarry

Vol. 8 Chicago, Ill., December, 1923 No. 3

Paint During the Winter

At this season of the year many pit and quarry operators either shut down their plants for three or four months during the winter or operate only parts of the plants. This period is naturally taken advantage of for making repairs and otherwise fixing up. Alterations and additions are also made at this time. While these things are being done it is a wise measure to see that everything around the plant is painted.

Rain and sunshine, water, steam, heat, cold, dirt and dust are sore decayers of both wood and metals. Even concrete is affected. The only way to keep wood, metal and concrete from destruction is to paint the surfaces.

If long periods of time are allowed to intervene between paintings, it is necessary to apply two or three coats to the structures, but if yearly paintings are done, one coat will generally be found sufficient. In every case, before paint is applied, the structure should be thoroughly cleaned of all dirt and grease.

Besides preserving material from slow oxidation, the annual painting so improves the looks of the plant that its appearance forms a valuable advertisement, and makes the men working around it have a keener interest in its welfare.

There are on the market many makes of paint and each manufacturer produces many different kinds, meant for distinct purposes or materials. It is therefore a mistake to use the same kind of paint on wood, metal or concrete, as the writer has frequently seen done.

The same thing is true in painting metal that is hot or cold. A different kind should be used for the two classes. Hot materials should be painted with metal paint meant for that purpose, while cold iron or steel should have some paint of carbonizing coating put upon them. Those exposed to coal smoke or gases should have put upon them a special kind meant for that purpose. Timber that is continually wet should be painted with some damp proof paint or wood preservative, otherwise it will soon decay.

Galvanized sheets, which are used extensively around quarries, should be painted with a mixture meant for such metal, for it is difficult to get the ordinary paint to stick upon such surfaces. It is a mistake to think that these sheets do not have to be painted for several years, for during that period much rusting can occur. It is true that the ordinary paint will stick on partly rusted galvanized metal better than on the new metal, but the oxidation once started, will continue and the only way is to paint the metal when new, with the proper kind of paint.

The same thing is true of concrete structures. From the day they are built slow disintegration takes place and paints and preservatives will prevent it. Where the concrete is in contact with water a special damp proof paint should be used. All other concrete surfaces should be treated with a regular concrete paint, for other paints will not adhere to concrete. Brick work is likewise preserved by paint. Floors, too, should be painted, as painting helps to preserve them. Even concrete floors can be preserved by using a concrete hardener upon them. This is especially the case if trucks must be operated over the floor.

Besides the plant, all equipment in it should be painted each year. Locomotives and cars, steam shovels and other excavators, wagon loaders and derricks, hoisting engines, and even crushers are thus protected and given longer leases on life.

If alterations and additions are made to the plant the painting should not be done until these things are finished. Quarry and pit operators can follow the same practice as steamship owners, who seldom employ special men for their painting, but employ their regular men in spare time to clean

and paint structures. Thus the only additional cost is the paint that must be bought. It has been said that the annual painting of structures pays dividends all out of proportion to the cost. The harder the uses of machines and structures, the more it pays to paint.

Portland Cement Sets New Record in October

Production of portland cement in October was the largest for any month this year and incidentally broke all records for a single month. Report of the United States Geological Survey just issued places the total production for the month at 13,350,000 barrels compared with 13,100,000 in September and less than 12,300,000 a year ago. For the ten months ending October 31, over 114,000,000 barrels were produced, exceeding last year's record output for the same period by 20,000,000 barrels or 22 per cent.

Shipments from the mills in October were 14,285,000 barrels, an increase of about 11 per cent over October, 1922. Shipments for the ten months were close to 119,000,000 barrels, or more than was shipped during the entire banner year 1922.

Stocks of cement in manufacturers' hands at the end of October were about 4,600,000 barrels or 450,000 barrels more than a year ago. Consideration of the fact that stocks of concrete at the beginning of the year were very much lower than at the beginning of 1922, and the ten months' shipments have been 17,000,000 barrels greater than last year, serves to indicate how successfully the industry has coped with the increased demand. The greatly increased efficiency of the transportation systems has helped materially in making this record possible and recent increases in productive capacity have given the industry a substantially greater output.

The American Crushed Rock Company has purchased sixty-five acres of land west of Ontario, Calif. (Los Angeles and San Bernardino Co.), where work has already begun on a plant to cost $150,000. The crushing plant, which is already under way, will have a capacity of sixty carloads a day. It is hoped that the plant will be in operation by the middle of December.

William Taylor Passes Away

On October 31 William Taylor, chairman of the board of directors of the Casparis Stone Company, died in Columbus, Ohio. His death marked the passing of a notable figure in the quarrying industry. Mr. Taylor was

William Taylor

an active quarry man for over forty years and his work has contributed in no small way to the advances made in the industry during that time.

Few men in the crushed stone trade were better known than he and none was more highly regarded. His genial personality attracted to him friends without number. He was a man who held the respect of all with whom he came in contact and the news of his death was received with genuine sorrow by all who knew him.

The funeral was held in Columbus on Friday, November 2; burial was at Newark, Ohio, on November 3.

The Atlas Portland Cement Company's Leeds, Ala., plant is working full force night and day, and orders coming in indicate that the Southeast is in for a prosperous season for the next few months, according to the Southern sales manager of this concern.

Safety Guards for Blasting

In blasting in quarries it is very essential that men should have a safe place to hide when blasts are put off. Otherwise much time is lost by the men in retiring to places of safety some distance from the blast. This is especially true of pit quarries where the space is limited and it becomes necessary in the interest of safety to have the men leave the pit.

In order to save this wasted time it is advisable to build safety spots or places fairly close to the work, to which the men can retire when blasts are put off. A number of such safety guards have been contrived in various quarries, but it seems that these contrivances are not well-known and have seldom been described in print, so they are not used in many quaries. The writer has built many of these safety guards and used them both in quarries and open cuts.

A word of warning as to using such safety shelters in blasting. For large primary blasts which are only made at long intervals it is not advisable to allow men to seek shelter in these temporary shelters, for, although an experienced blaster has some idea and can tell fairly well how his material should be thrown down by the blast, the unexpected can and does happen, and large masses of rock may be thrown great distances and with such force as to completely cover up or throw down a temporary safeguard. There should be a strict rule in every quarry that when heavy primary blasting is being done men must retire to a safe distance to be decided upon by the superintendent.

The best means of saving time when secondary blasting or the breaking of boulders is being done, is to plan this work so as to do it either during the noon hour or when men quit work in the evening. Then the men have left the quarry, with the exception of the blasters, and there is no loss of time. However, the safety shelters are then used by the blasters, and they prove a great convenience and protection for them. It is not always possible, especially when steam shovels are worked in a quarry, to time all the boulder breaking for those periods when the men are not at work. For, if the shovel unearths a large boulder that is directly in its path, it means a wasfe of time trying to dig around it and it is better to blast and break up this boulder at once. It is then that the safety shelters are needed.

It can be seen that, although the use of these shelters can be reducd to a minimum, yet even with the best of management there are times that they can be used and mean the saving of much money through lost time by the men.

As previously stated, there are a number of ways to build these safety guards. All of them utilize old material, so it is not very expensive to build them, except for the labor. With an acetylene torch, old boilers and tanks can be cut up and lagged on the top and sides with old railroad ties and logs by drilling bolt holes through the metal and fastening the lagging to the iron. Such guards as these will hold from three to six men, according to their size, and can be moved around upon the quarry floor. The bodies of old steel cars can be fixed up in the same way and used for the same purpose. The writer has also used old wornout steel derrick skips, using heavy timbers to prop up one end. These, too, can be moved as desired, the idea being to keep the safety guard within a reasonable distance of the blasting work, so that men will not have too far to walk back and forth to them.

It is also possible to build these guards of old railroad ties or logs. A heavy frame can be erected on two poles sunk into the rock or fastened by mortise and tenon to a log lying on the ground. The logs or ties are then leaned against this frame and, if necessary, can be covered by dirt or rock. This makes an excellent safety place, but is not as easily moved as the other contrivances that have been described.

They are in many ways, though, better than the guards that are so easily moved. Similar contrivances will no doubt be suggested to the reader that may suit his condition better than these. The main thing is tc have some place of safety to whicl. men can retire when boulders are being broken with dynamite and other small blasts are being made.

Freeport Sand Company, Freeport, Pa.; capital $20,000; purpose, manufacture of brick, tile and building materials. Incorporators: W. Earl Iseman, Tarentum; William N. Ferguson, Freeport; W. Fred Turner, Freeport.

What Do You Expect of Your Crane?

By WALTER S. DOXEY, Assistant General Manager of Sales, McMyler Interstate Company.

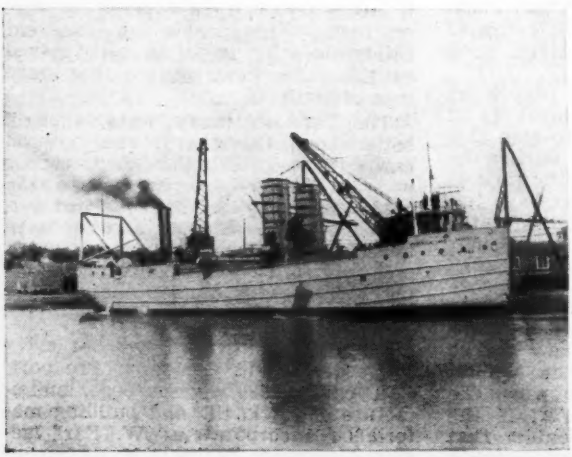
A contractor was pulling out sheet piling with his 20-ton capacity locomotive crane, the boom being conveniently extended over an intervening obstruction to bring the fall block over the piling. In theory, the plan was simplicity itself; the piling must come upward toward the boom or the boom must go downward toward the piling. Since the crane was heavy and the boom was placed parallel to the tracks, the contractor figured the crane would stay on the rails and the piling would move.

This result was produced with satisfying regularity until the line was hitched to a particularly tight and stubborn piece of piling. Then the boom collapsed.

The piling was later started with a hydraulic jack under a pressure of 40,000 pounds. Since 40,000 pounds is the equivalent of 20 tons, the rated capacity of the crane, the contractor could not understand why the boom failed. And so frequently are the ratings of standard locomotive cranes taken at their face value as indicative of the work they should do under all conditions that it seems advisable to outline for owners and operators of cranes in sand and gravel pits and in quarries the real significance of rated capacities.

Primarily, two factors affect the capacity of a standard locomotive crane, that is a 4 or 8-wheel crane built for a track gauge of 4 feet, 8½ inches, and not exceeding a nominal railroad clearance height of 16 feet. The first factor is stability; the second, available line pull. The stability of a crane varies with the angle of the boom or the working radius, that is, the distance from the rotating center to the center of the lines dropping from the end of the boom. The available line pull is, of course, constant at all boom angles and radii.

Under ideal operating conditions, the weights or loads on a crane, distributed about its center are equally balanced on any one axis. Practically, this condition is never achieved although an effort is made to approach it as nearly as possible. If we consider the axis that extends from the rotating center of the crane and coincides with the projected center line of the boom, it is apparent that any load suspended from the end of the boom must be balanced as nearly as possible by a counterweight on the opposite end of the turntable. If this balance is not obtained, there is a tendency to tip. Since then overturning tendency or moment is equal to the weight multiplied by the distance of the weight from the center, and since the position of the counterweight is fixed, then it will be seen that as the boom is extended and the distance from the rotating center is increased; the weight that can be suspended from the end of the boom must be correspondingly decreased.

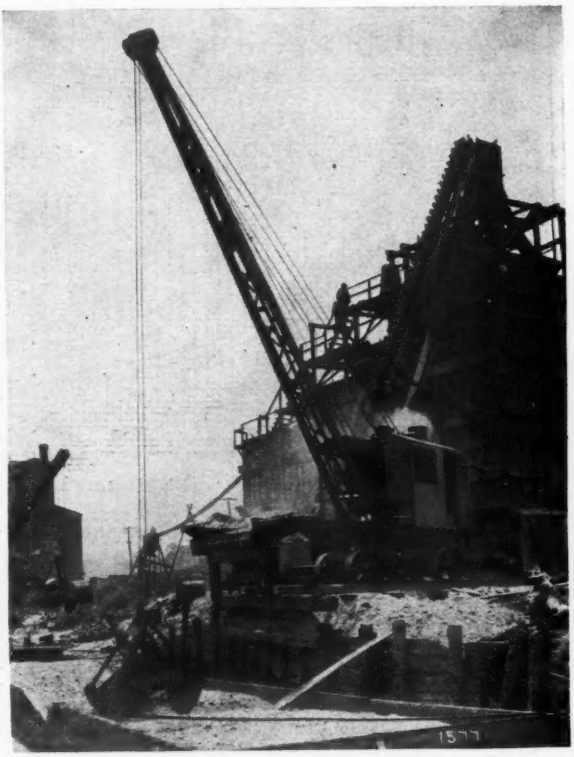


Crane used for unloading a "Sandsucker"

It is customary, therefore, for manufacturers of locomotive cranes to supply with each machine a capacity table or diagram showing the safe loads that can be handled at various boom angles. To exceed these loads means that you are risking the overturning of your crane and at the same time imposing severe

strains on various parts of the mechanism.

Figure 1 shows the decrease in the safe lifting capacity of several sizes of standard locomotive cranes due to the stability factor of each. Each of the curves in this chart begins at 12 feet, this being the radius, at right angles to the track, at which each machine will lift its maximum load. For comparative purposes and as a means of standardization, this maximum load is taken as the rated capacity. To be rated in this manner, however, a crane had sufficient stability to give a moderate safety factor; it must also be able to handle a certain minimum load with a 40-foot boom at 40-foot radius.



Crane used for unloading gravel barges.

From the standpoint of operators of a sand and gravel pit where materials are handled with clam shell buckets, Figure 2 will be of interest. This indicates the available capacity of the cranes shown in Figure 1 for handling materials after allowance has been made for the weights of buckets. In drawing these curves, average weight buckets have been used with booms of usual length.

A factor which is frequently overlooked when ascertaining the causes for the overturning of cranes during operations with clam shell buckets is centrifugal force. With the boom well extended carrying a bucket fully loaded, centrifugal force will tend to throw the bucket several feet outward if the crane is swung rapidly. The radius of the load from the rotating center is materially increased; the stability is exceeded and the possibilities for tipping are excellent. After the crane has tipped and a check is made to ascertain the causes, no evidence remains to explain the accident.

In an effort to increase the operating radius of a crane and to reach remote portions of storage piles, operators sometimes throw empty buckets several feet beyond the ends of booms by swinging rapidly as the buckets are lowered. This practice should also be discouraged.

Faulty guesses as to the capacities of clam shell buckets and as to the weights of materials being handled contribute to unsatisfactory service from locomotive cranes. Either the crane is overloaded else it is operated inefficiently.

The second factor contributing to the capacity of a locomotive crane—available line pull—determines the rapidity with which the loads may be handled, it being customary to state the available line pull in pounds at a certain rate of feet per minute. This factor is necessarily individual to each crane and is dependent upon the size of boilers, engines, characteristics of clutches and other details of design and construction.

In the quarry, the sand or gravel pit, as well as elsewhere, the character of the material to be moved, the nature of the equipment required, the

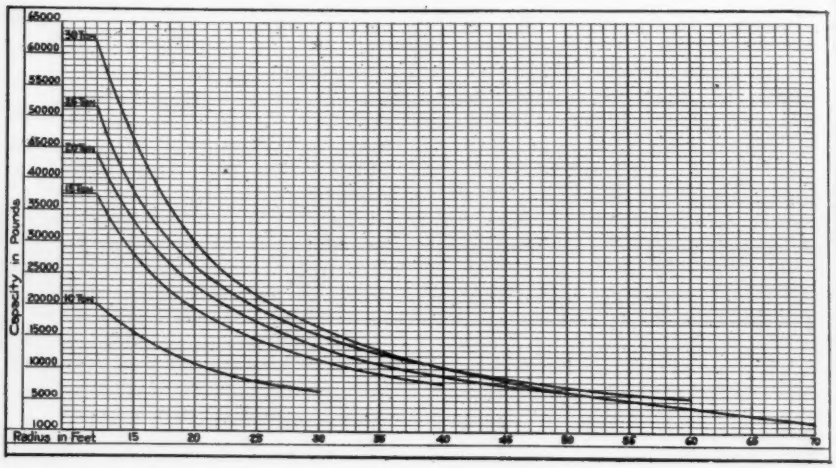


Figure 1.

rate it is moved and the amount of labor necessary are all represented on the ledger which showns the final cost. In proportion to the investment and because of the relatively large quantities of materials handled in a unit of time, the modern locomotive crane is almost indispensable. Not only will it perform its assigned duties regularly and with a skeleton crew, but it is instantly available for all kinds of hoisting and for shifting loaded and empty cars. It is easily converted into a practicable pile driver. However, when used for a specific purpose over a period of months the economy shows to best advantage. If you have maintained your records carefully, you will find that your crane will handle gravel at approximately 6 per cent the cost of hand methods. In sand the cost is about 7½ per cent and in crushed stone, 10 per cent.

The Guadalupe Portland Cement Company, Humboldt Bank Bldg., San Francisco, has purchased 250 acres of land back of the Almaden quicksilver mine, San Jose, where they will construct and operate a cement manufacturing plant. The company was but recently organized, as reported in our August issue.

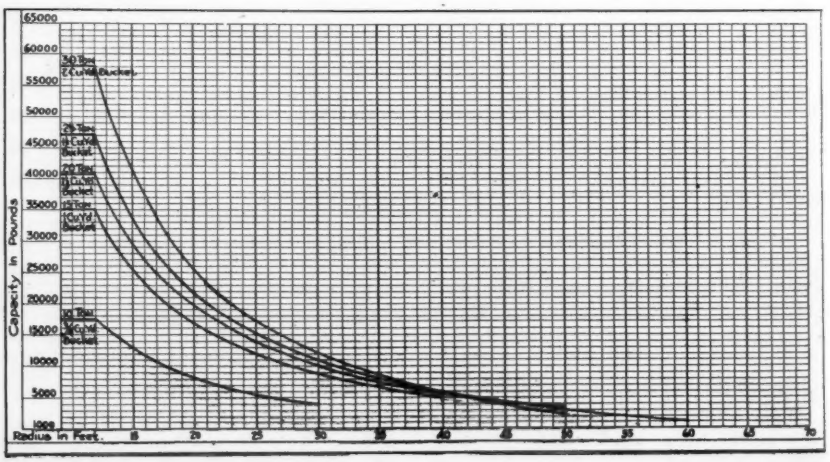


Figure 2.

A Blue Diamond Truck Delivering Ready Mixed Mortar to the Job.

Another Wet Mortar Plant

Cleveland, Ohio, home of many important pit and quarry industries, is fortunate in securing a new enterprise that bids fair to win for itself a prominent place in the building activities of the community. This enterprise, a new Blue Diamond plant, is already justifying the hopes of its promoters, although it has been in operation for only a short time, and that during a season of the year when the best business cannot be expected.

The Blue Diamond Material Company of Cleveland is under the direction of Mr. John M. Truby. The plant was designed and erected by the Sturtevant Mill Company of Boston under licenses granted by the Blue Diamond Material Company of Los Angeles. The plan of producing and distributing to contractors a mortar ready for use was devised and worked out by Mr. W. C. Hay, vice-president and general manager of the Los Angeles organization, a number of years ago and has been in successful operation since that time in six or seven plants on the Pacific coast.

The plan of producing and selling prepared mortar is fairly well known to most lime producers of the country and is gaining steadily in popularity. Plants have been erected in quite a number of centers and are proposed for a number of others. The idea would seem to be a very good one in fairly large centers where delivery can be made with rapidity. The purchase and use of a prepared mortar frees the builders from a lot of the bother and inconvenience of mixing up mortar on the job. It insures, too, the production of a better product, made under controlled conditions and with accurately determined amounts of the component materials.

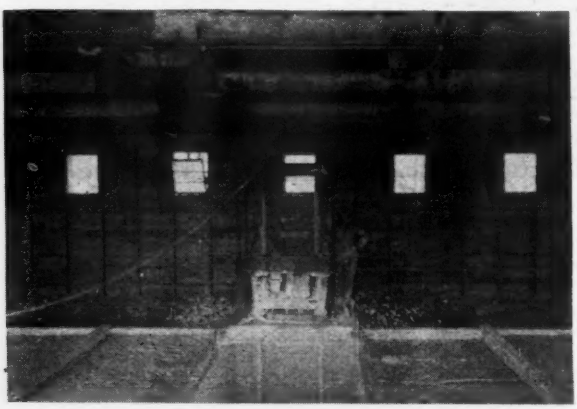
While the plan can be operated by a concern engaged neither in the production of sand or of lime, it naturally fits best into the activities of a lime or sand producer. The lime manufacturer would ordinarily be expected to take to the idea more kindly, since it would open up for him opportunity for the better control of the market for a higher priced product than that

furnished by the sand producer.

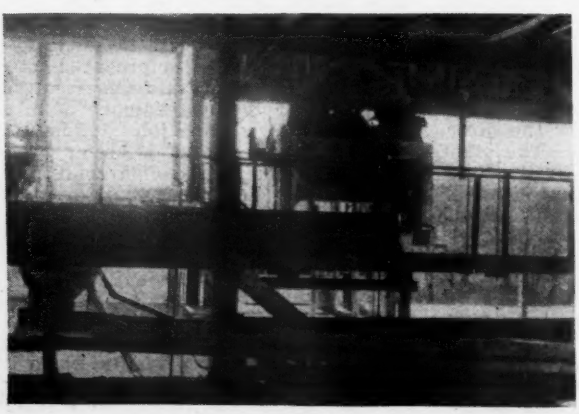
The Cleveland operation is located some five or six miles from the business center of the city, thus making it possible to effect quick delivery to jobs at any point. The plant in which the mortar is produced is close by the gravel pit of the Cuyahoga Sand & Gravel Company. One of the raw materials, and that whose cost is most greatly affected by transportation, is thus delivered to the plant without unnecessary expense. Lime is brought from a greater distance. It is most frequently purchased in northern Ohio, an important lime producing district. It is possible, however, for the concern to bring in lime from more distant points and still keep the plant operating successfully.

In brief, the producing method calls for the slaking of quicklime, the ageing or curing of this lime over a period of time and the mixing of measured amounts of lime and sand to form the finished product. The Cleveland plant differs in operation from other Blue Diamond plants in that the mixing is a batch operation rather than a continuous operation.

Lime is delivered to the plant in trucks, dumped into a hopper from which it is carried by elevators to a steel bin and from that point on carried through the various processes of slaking, screening, curing and mixing. Sand is delivered in trucks to a hopper at the front of the plant shown in one of the illustrations. From this ponit it is conveyed by an inclined bucket elevator to a large steel storage hopper at the top of the plant. It is drawn off from the hopper in one-yard batches, meets the flow of lime in a mixer and passes from here to delivery tanks, of which there are two, each with a capacity of four yards. The contents of one of these tanks is just sufficient to make up a full load for the company's truck, shown in one of the illustrations.



View of Agitators and Part of Curing Vats.



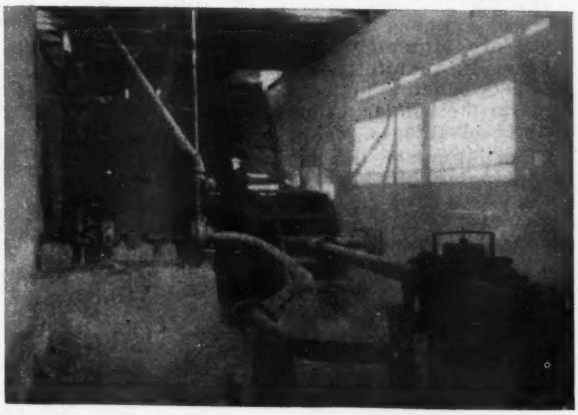
Filter which Removes Water in Preparing Lime Plaster.

The first machine in the process of reducing the lime to the proper condition for making a good mortar is the slaker. This piece of equipment is essentially a long steel tank with straight sides and a half round bottom with mixing blades mounted on a shaft running the length of the tank and operating on the principle of a combined agitator and screw conveyor. The lime, to which water has been added, is carried to one end of the slaker, where it is drawn off and passed through a screen which scalps out all cores and solid particles.

Materials that pass the screen go through a chute to a wooden flume. This may be adjusted to discharge in any one of 8 concrete vats, 40 feet long, 8 feet

wide and 6 feet deep. The slaked lime is allowed to remain in these vats for a period of about 30 days, during which time it gradually assumes the character most desirable for use in a lime mortar.

This is one of the most important features of the entire process. Lime to be really effective in a mortar must be properly aged. In some countries the length of time for this curing process is established by law, and in most of these cases the length of time is considerable, too long, in the opinion of many who are competent to judge.

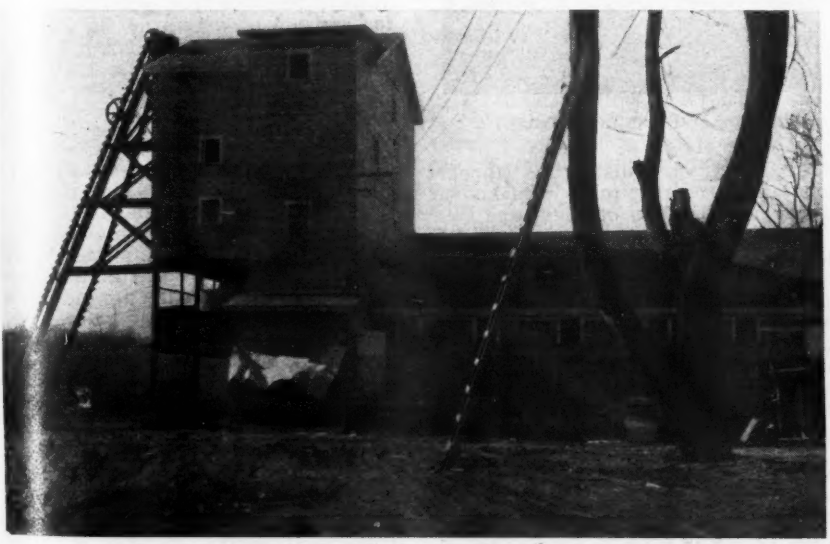


Cured Lime Pumped from Vats by Centrifugal Pumps.

While it is curing in these vats, the lime is subjected periodically to the action of a traveling agitator shown in one of the illustrations. This agitator employs the principle of revolving blades set at the proper pitch to give a churning effect. These blades are mounted on vertical shafts running down from a carriage spanning a vat and operating on rails along the full length of the vat. This agitator may be used on any one of the eight separate vats by raising the propellors to a sufficient height to clear the ends, running them on a transfer track and from this to the vat in which it is desired to carry on the operation.

After the lime putty has been in the vats about 30 days, it is pumped out by a 6-inch centrifugal pump and elevated to a lime bin at the top of the plant. Measured amounts of lime go from this bin to the mixer, meeting the batches of sand accurately measured out in yard quantities.

The mixer is built on the principle of a revolving drum supported on



General View of Plant from Side.

trunnions and gear driven. In this piece of equipment, the sand and lime putty are intimately mixed and the product is a uniform, properly compounded building material which affords to the builder a number of very distinct advantages.

From the mixer, the mortar goes to the shipping bins or tanks already mentioned. Each of these tanks contains four yards of the material, enough to make up a full load for the truck. This truck, painted white and with a blue diamond showing at each

View of Plant from Front.

side, has a very distinctive appearance and is coming to be well known among the builders of Cleveland.

In addition to the mortar business the company is developing a lime plaster trade. A good material for this purpose is supplied by filtration of the lime putty as it is taken from the vat. The filter is a machine which employs a set of revolving filters and utilizes centrifugal force. The effect produced is the removal of a large quantity of the water and the output of a material ready for application on the wall as a finish coat. Considerable attention is being paid to this feature of the business, which is expected in the future to assume quite respectable proportions.

Prominent Manufacturer Dies

George B. Loomis, president of the Loomis Machine Company, died on November 1 at Tiffin, Ohio.

Mr. Loomis was known throughout the quarrying industry as a manufacturer of blast hole drills. The services that he rendered to the quarry men of the country were important. For years he had been giving to the trade the benefits of his thorough training in the design and manufacture of drilling machinery.

Mr. Loomis was a prominent citizen of Tiffin. Besides the presidency of the Loomis Machine Company, he also held the offices of president of the Tiffin National Bank and of the Tiffin Wagon Company.

His death will be sincerely regretted by the many in the industry who had an opportunity to know him.

Utilization of Anhydrite

Anhydrite, which occurs in considerable quantities at some gypsum mines, is now practically a waste material. Steps have been taken by the Department of the Interior, through the Bureau of Mines, to determine the amount of anhydrite available at various plants, and the possibility of finding useful applications for it in industry, for example, as a substitute for gypsum as a retarder in Portland cement. This work is being done at the non-metallic minerals station of the Bureau of Mines at New Brunswick, N. J.

W. A. Flynn is general manager and director; P. D. Richards, engineer.

The International Cement Corporation earned in quarter to September 30 a surplus of $755,623, against $432,929 for the third quarter of 1922. Earnings after allowing for preferred dividends, are equivalent to $4.87 per share for the 9 months of this year on the 364,167 shares of common stock, against $2.72 per share on 324,722 shares of common in the same nine months of 1922.

Berks Cast Stone Company, Reading, Pa.; capital stock $5,000. To manufacture cement block. C. Harry Muth, Reading, treasurer; Samuel M. Sherman and E. Weiss, both of Reading.

Selection of Harvesting Plant for Sand and Gravel Pit

By VICTOR MILKOWSKI, Morris Machine Works.

In considering the choice of harvesting equipment for sand and gravel pit, one becomes immediately aware of such a multitude of questions and consideration that it appears well nigh impossible to reach any decision through the ordinary methods of logic. The proof of this is to be found in the fact that no two plants have the same conditions and requirements or ever use identical equipment.

The term "harvesting" plants as used in this article includes the equipment used in excavating the material and transporting it to the screens or classifying plant, without considering the screens themselves, although the type and size of screens are affected considerably in some cases by the type of harvesting equipment.

Victor Milkowski.

By adopting broad general principles the harvesting plant in use at the different sand and gravel pits may be classified as follows:

No. 1—hydraulic dredges.
2—cableway excavators.
3—steam shovels and dump cars.

There are many special cases and modifications of these three types, too numerous to be described in this article but the three types may be considered as being the fundamental ones.

The choice of the type of a harvesting plant for any particular pit is determined mainly by the following considerations:

1—the nature of the deposit.
2—its location with respect to water.
3—the location of the screening plant with respect to the deposit.

In considering the nature of the deposit, the following characteristics are important in deciding the choice of the harvesting plant:

A—whether the deposit is loose or consolidated.

B—the percentages of the different sizes of material.

C—the depth of the deposit.

Deposits in rivers and along the beaches are generally loose and uniform, containing but very little coarse material; such deposits occur in comparatively thin layers. Deposits of this character are the usual sources of supply along the Ohio, Mississippi and Missouri Rivers.

Alluvial deposits are similar to the river and beach deposits but are of older origin and are usually quite well consolidated. Deposits of this character are found most frequently along the coastal plains and in the southern states.

The glacial deposits which are the usual sources of supply of sand and gravel in the northern states are very irregular both as to depth and composition and frequently contain thick layers of clay or large masses of cemented material. For these reasons the glacial deposits should receive the most careful study before the type of equipment is selected.

The second consideration affecting the choice of the harvesting plant, that is, the location of the deposit with respect to water varies as follows:

A—the deposit may be entirely submerged.

B—the deposit may be partly submerged and partly above water level.

C—the deposit may be entirely above water level.

The deposit in rivers and along beaches are practically always sub-

merged. Alluvial and glacial deposits are usually partly submerged and partly above the water level. Cases where a sand and gravel deposit is entirely above water level are quite rare and occur only where the deposit is on the side of a hill where the water can drain off through underground channels.

The third consideration affecting the choice of the type of plant, that is, the location of the screening plant with respect to deposit is really dependent on the method of shipment of the finished product. The logical location for a screening plant is as close as possible to the deposit but where the material can be loaded directly into trucks, cars or boats without subsequent rehandling. It will be usually found economical to reduce the distance between the screening plant and the deposit to the minimum, even if that will require the construction of a special track or roadway to the plant.

A study of the foregoing makes it evident that usually the choice of the harvesting plant is not limited to one particular type of equipment and that a decision can be made only after a very thorough study of the particular pit.

Considering next the application of the different types of harvesting plants to the different conditions and taking up first the hydraulic dredge, it may be stated in general that a dredging plant can be used in a deposit that is fairly loose, does not contain too much large material that would choke up the pump, is submerged or partly submerged and where the distance from the screening plant and the required lift are not excessive.

The particular advantages possessed by a dredging plant are that it is well adapted to large scale production, that the material can be excavated and delivered to destination at one operation, that the material becomes disintegrated, washed and scrubbed most thoroughly when travelling through the pump and pipe line, thus reducing considerably the work on the screens, that all of the material can be reached readily within a certain radius from the plant and within a certain depth below water surface depending on the size of pump used, and that the costs of upkeep and labor are comparatively low.

The drawbacks to a hydraulic dredge are that for any considerable distance or height it requires a large expenditure of power, that it can handle only stones up to a certain size, depending on the size of the pump that it is limited to a certain depth below the water surface, depending on the size of the pump, the maximum practicable depth being about 60 feet, and that it is not suited for operating in very hard material or material containing many large boulders.

The second type of equipment—the cableway excavator—can be used in a loose deposit of considerable depth, either above or below the water surface if the distance from the screening plant and the required lift are not too great. The particular advantages possessed by this type of plant are that the material is excavated and delivered to the screening plant in one operation and that the labor costs are low. In addition it may be said that while it cannot be used for handling very large boulders it can operate in a deposit containing a larger percentage of oversize than would be practicable with a dredge of similar capacity.

Some of the drawbacks of cable excavators are that they can be operated only in a loose deposit of considerable depth, that the upkeep is high, depending largely on the nature of the deposit, and that they are subjected to frequent interruptions.

The third type of harvesting plant, that is, the steam shovel in conjunction with dump cars, can be used in deposits containing hard material and large boulders but only above water surface. It is permissible with this type of plant to have the screening plant located at a considerable distance from the deposit.

The particular advantages of this type of plant are that it can be used in hard material and that the excavated material can be delivered to a considerable distance, i. e., the screening plant can be located some distance from the deposit.

The disadvantages of this type of plant are that it can excavate only the material above water level; the labor costs are high and the cost of operating and upkeep are high.

To illustrate the foregoing discussion with an example, we will assume a typical sand and gravel plant with a capacity of 150 tons of material per hour, the deposit being loose

Typical Hydraulic Dredging Plant Equipped with Booster Pump.

sand and gravel, 50 feet deep, 25 feet of which are above water level and 25 feet below water level, and with the hopper or point of delivery incoming material on the screening plant above 50 feet above the water level.

The conditions as given so far would permit the use of any of the three types of harvesting plants described here.

Considering first the dredging plant, the capacity as specified would require a 12" pump; with about 350 h.p. provided for the operation of the dredge the specified output could be maintained in average sand and gravel deposits up to a distance of about 800 feet from the plant if the material were delivered directly to the top of the screens.

By installing a booster pump and providing additional 300 h.p. or a total of about 650 h.p. the radius of operations could be increased to about 2,000 feet and the material still delivered to the top of the screens at the required rate.

The maximum size of stones which the 12-inch dredge could handle is about 8½ inches; should the deposit contain any considerable percentage of material exceeding this size, a hydraulic dredge would not be practicable. It would also be impracticable to operate a dredge in a deposit containing a large number of boulders or large masses of cemented material, although streaks of clay and cemented material and deposits of firmly consolidated material can be overcome by providing the dredge with a suitable cutter or agitator on the suction.

Ordinarily no stripping of any kind would be necessary with the hydraulic dredge.

Above is shown a typical illustration of a hydraulic dredging plant with a booster pump delivering material directly to screens.

Considering next the cableway excavator, the capacity specified would require a 2½ cubic yard bucket; the excavator could dig and deliver the material to the receiving hopper within a radius of about 700 feet from the screening plant.

To operate the cableway excavator under such conditions would require about 150 h.p.

While a bucket of this size could handle large material, it would not be practicable to use it in deposits containing many large boulders or heavy layers of hard or cemented material.

Unless the overburden is very light, stripping would be necessary with this type of plant.

Other pages give typical illustrations of this type of harvesting plant that show the method of installing and operating this type of equipment.

The third type of equipment, i.e., the shovel and dump cars, would ordinarily require for the specified capacity a shovel with a 1½-yard dipper, two 18-ton locomotives and about 20 6-yard dump cars, when operating within a mile or less from the screening plant.

With this type of equipment only that portion of the deposit above water level could be recovered but it would be permissible to have the screening plant located at a considerable distance from the deposit, as the material could be hauled the extra distance with very little additional cost. In fact, it may be stated as a general rule that where it is necessary to have the screening plant out of reach of the dredge or the cableway excavator, the shovel and dump cars will be found to be the most economical if they can be used at all.

The heavy shovel of modern design can be operated in the very hardest material; large boulders or hard strata of material can be left in place more readily with a shovel than with the other types of equipment.

It is necessary, with the dump cars, to deliver the material into a hopper at the foot of the screening plant and to elevate the material to the top either with a conveyor belt or elevator.

Stripping is generally required with this type of equipment.

The author hopes that the reader will not be disappointed to find no ready solution to his own particular problem, because, as said in the beginning, such a solution can be arrived at only after a thorough study of the particular pit.

The Clamshell Bucket In Excavation

By WM. MAYO VENABLE, Member American Society of Civil Engineers, Blaw-Knox Company

Clamshell buckets have been used very satisfactorily in excavation. They are, however, based upon different principles from those employed by steam shovels and other excavating equipment; in order to determine when to use a clamshell and when to use some other type of excavating equipment, experience in actual excavation is essential. Some principles, however, may be laid down which will serve as a general guide.

In the first place, a steam shovel is constructed so as to be able to exert great force, pressing the scoop into the material to be excavated. The steam shovel is betted adapted for penetrating material and should be used in excavation in preference to the clamshell wherever a steam shovel is available and certain conditions do not interfere with its proper application.

The conditions which may interfere with the application of the steam shovel are narrowness and depth of the excavation, rendering it impracticable for shovel to work at the bottom of the ditch and deposit material into proper cars outside the excavations or of the excavation shape, which may not allow the proper manipulation of the shovel. A steam shovel also is inconvenient to use in an excavation which is likely to be flooded; it is quite impracticable for certain kinds of work on that account. In order to use a steam shovel to advantage, moreover, it is usually necessary to have a considerable amount of material to handle.

The clamshell bucket has no means of pushing the scoops downward into the material. The only downward acting force is the weight of the bucket itself, all of the pull applied on the hoisting lines from which the bucket is suspended tending to lift the bucket out of the material. The clamshell bucket, therefore, operates by having the lines reeved in such a way that the two opposing scoops are drawn together so that they enter in opposite directions into the material with a shoveling or a scraping action; in no event can the downward component be greater than the total weight of the bucket and load within the scoops, less the upward pull upon the lines.

There are, therefore, only two ways of building a clamshell bucket so that it will exert a considerable penetrating action upon the material between the scoops. One is to make the bucket itself very heavy and the other is to make the upward pull upon the line very small. In the first case, it is easy to make the bucket very heavy in proportion to the amount of material it will pick up. In the other case, if the line pull is to be small in order to close the bucket, there must be a great deal of line pulled in closing; therefore, a large number of pulley blocks in the closing mechanism. The clamshell bucket, therefore, is not especially well adapted for ex-

cavating material which is difficult to penetrate; an ordinary clamshell bucket should not be used for that kind of work, it being necessary for buckets intended for that kind of work to be designed extra strong, extra heavy and with extra closing power.

For the excavation of loose soil, sand, gravel, plastic clay and similar materials, the clamshell bucket has no equal if the work be not especially adapted for the steam shovel. The weight of the bucket for such work need not be excessive and the reeving need not be so powerful as to cause difficulties in order to obtain it. Therefore, in operating a gravel or sand pit or in handling other loose materials, most particularly in placing materials from cars or barges into strong piles and recovering them from storage piles for use, the clamshell bucket has every advantage. It can be attached very readily to portable cranes or to fixed derricks, can be operated at very high speed and swung through the air over long distances, none of which can be accomplished with a steam shovel.

The design of the clamshell bucket is not as simple a matter as a novice might suspect; in fact there is no clamshell bucket on the market now that is doing satisfactory work that has not been designed by men who have had years of experience. The pitfalls that the amateur designer is likely to fall into are due to the fact that practicable mechanisms for closing the bucket differ in their capacity for applying the closing forces to the lips of the bucket at different openings. Some buckets exert a very powerful grappling force when the bucket is wide open, but almost no closing force when the bucket is nearly shut. Such buckets may be built very light and are quite suitable for handling such materials as anthracite coal, but are entirely unsuitable for handling such materials as crushed stone.

The unwary designer is also likely to face difficulty owing to making the bucket exceedingly powerful for closing, with the result that the bucket in opening cannot exert sufficient pull on the line to overhaul the engine of the derrick or crane upon which it is being used. The shape of the scoops of the bucket and relative positions of the different hinges are very important items, depending upon many factors, such as the kind of material to be handled and the type of hoist upon which the bucket is to be employed. The clamshell bucket is also exceedingly convenient for use on the many kinds of special hoists, which can be applied to cableways, to monorails, to coal, ore and other bridges, as well as to all types of cranes.

From the foregoing it should not be concluded that where circumstances require it a clamshell bucket cannot be used to advantage in handling material that under other conditions could be handled better by other means. Certain types of buckets can be built to handle heavy broken stone, ore, slag, boulders and hard bank clay to advantage. These buckets, however, cannot be the same as those used for rehandling sand, gravel, coal and broken stone of moderate size, without sacrifice of efficiency. The handling of difficult material should be considered as a different kind of problem from the handling of loose materials which are easily picked up.

According to Thomas Winslow, advisory industrial engineer for the Japanese government, who arrived aboard the liner Kroonland in Los Angeles recently from New York, cement will play the chief part in the permanent reconstruction of Tokio and Yokohama. Although Japan is importing industrial ideas from all over the world, Mr. Winslow said, the American influence is dominant particularly in matters of capacity production. The stricken cities have a grand opportunity to rebuild as the most modern in the world, and they are making the best of it, he said.

In this connection, we might also mention that Homer M. Hadley, district engineer in charge of the Portland Cement Association office at Seattle, as previously reported, sailed for Japan October 5 to make a thorough investigation of how modern structures, particularly those consisting largely of reinforced concrete, withstood the recent earthquake.

Freeman T. Eagleson, as receiver of the Phoenix-Portland Cement Company, has issued a statement to stockholders of that company suggesting that they keep their stock until it can be determined what return the company is to pay upon it. The letter, it is indicated, results from an effort being made by some undisclosed parties to purchase the stock at a trifle of its value.

The Dragline Excavator For The Gravel Plant

By BRADLEE VAN BRUNT, The Bucyrus Company

The word "dragline" as applied to excavators has lead quite frequently to some confusion. There are a number of types of machines that have from time to time been referred to by this term. The cableway machine for example, which is more properly known as the cableway excavator, is occasionally and erroneously called a dragline excavator. Similarly might also be mentioned the tower excavator, principally used for levee construction and other work requiring a very large span. This machine and the smaller types of machines which operate scraper buckets from stationary or semi-stationary hoisting engines, are occasionally mentioned as dragline excavators with resulting confusion. The dragline excavator, however, as the term is probably used, is applied to the revolving excavator mounted on skids and rollers, or caterpillars, trucks or other walking or propelling devices, which is equipped with a long boom from which a drag scraper bucket is operated.

All the advantages of the dragline for gravel pit operation are made possible by the long boom and the full circle swing. These features not only make possible the depositing of the material at considerable distances from the point where this material was excavated, with far less movement of the machine itself, but enable it to dig below its own level, thus obviating the handicap of flooded pits, as the bucket can operate as well under water as in dry material.

Dragline excavators as built today range in size from those with 35 foot booms to the great machines, with booms 155 feet in length. The gravel pit operator therefore has a very wide range from which to choose the best tool for his pit. The smaller and medium sized machines, that is to say, those with booms from 35 to 60 feet in length and buckets from 1 to 2½ cubic yards capacity, appear to have been by far the most popular, although there seems to be a growing tendency with the increasing knowledge of the capabilities of the dragline, toward the larger machines with 100 foot booms and 3½ cubic yard buckets. It is difficult if not impossible to lay down any general rules as to the proper size machine for any given operation, because of the fact that so much depends upon local conditions. Similarly, it is difficult to cite any common practice.

Stripping Operations

The dragline naturally has two specific purposes in the gravel plant—the stripping of the overburden and the loading of the gravel. Let us consider the stripping problem first, as this is ordinarily by far the more troublesome. In cases where the overburden is thick, the manner of removal has not infrequently made an unprofitable venture out of a good one. By failing to plan his operations well ahead of time, many an operator has found himself hopelessly tied up with mountains of earth effectually sealing up his valuable deposit. In many plants where the over-

Illustrating the Wide Area Over Which a Dragline Operates.

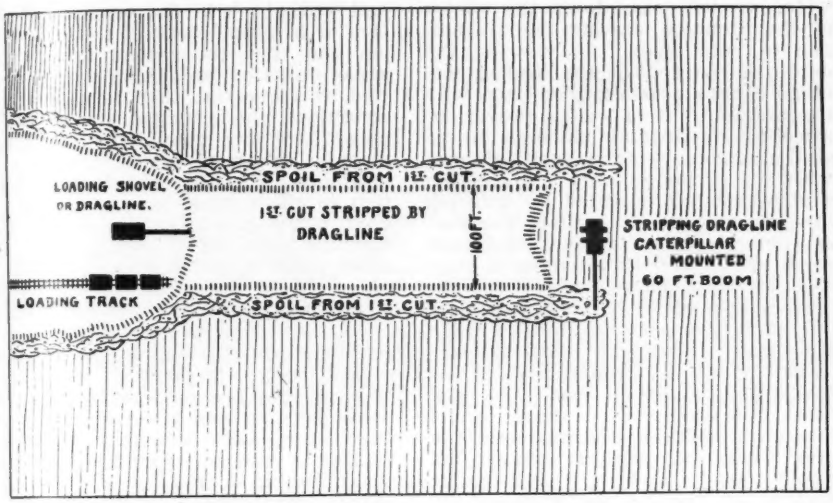

SPOIL FROM 1ST CUT.
LOADING SHOVEL OR DRAGLINE.
1ST CUT STRIPPED BY DRAGLINE
100 FT.
STRIPPING DRAGLINE CATERPILLAR MOUNTED 60 FT. BOOM
LOADING TRACK
SPOIL FROM 1ST CUT.

FIG. 1.

burden is uneven or where it is comparatively light, it has been a common practice to head the steam shovel into the bank and allow the overburden to cave down with the gravel and send the two to the washer together. This method is almost certain to result in loss of time and output with periodical "plugging" of the plant. The operator is often confronted with the problem of the disposal of the mountain of waste material which is bound to accumulate beside his washer. In cases where it is considered possible to transport the overburden to available waste areas the cost of production is frequently run up to prohibitive figures. Again, an uneven surface frequently prevents the use of the steam shovel without a large percentage of waste.

In all such cases the dragline excavator has proved a most effective solution. In the first case mentioned, it has been found economical in many instances to replace the old reliable steam shovel with a large dragline, even where the overburden is comparatively light. In such cases the size of the deposit often determines whether two machines or one machine should be used, in the former case one to handle the stripping and the other the actual loading of the gravel. In the case where one machine is employed the size thereof is limited by the mobility, as it is naturally important to install a machine which can be moved from one part of the property to the other with the least possible delay or trouble. Let us consider the instance of a plant of large capacity where the overburden is of clay, we shall say, from two to six feet in depth, and the underlying gravel from 50 to 70 feet in thickness. Such property would ordinarily warrant the installation of two machines, one for stripping the overburden and the other for loading the gravel. In planning the method of stripping the overburden, it is obvious that care must be taken in planning the cuts to protect yourself from the danger of rolling up in successive cuts, great ridges of overburden, which must be handled two and three times. Such a procedure would eventually result in a cost of stripping which would effectually prevent satisfactory profit.

It is obvious that in selecting a machine one with as great a reach as possible should be chosen. However, the limiting factor in this choice is mobility, as the machine must be moved from one part of the property to the other to handle the cuts most effectively. Consequently, the most economical size is perhaps a dragline mounted on caterpillars with a 60 foot boom. This is the largest size so mounted at the present time. Such a machine carries a 2 cubic yard bucket.

The suggested method of operation is indicated in Figures 1 and 2. In Figure 1, it will be seen that the dragline first carries a cut about 100 feet

wide, we will say, down the center of the property, casting the overburden to both sides. In view of the depth of the deposit the loading machine cannot possibly keep pace with the dragline. It is well, however, in selecting the loading machine, to install a machine which is well balanced with the stripping unit. Ordinarily, a steam shovel mounted on caterpillars, we will say, is perhaps the best solution, but in some cases that have come to the reader's attention a dragline has been chosen where the deposit is intersected by tongues of clay and pockets of sand and other foreign materials. Frequently such pockets extend below the normal floor of the pit 30 and 40 feet or more. In such cases operation with a shovel would result not only in the wastage of a great deal of valuable gravel but would also send a considerable amount of clay to the washers, resulting in the before mentioned "plugging" of the plant. A dragline, on the other hand, could follow the pockets down to the bottom and reclaim the material; also the well trained operator could easily pick out and cast aside the tongues of clay in the deposit, thus effectually assuring a clean product.

The loading machine, however, whether it be a shovel or dragline, would follow up the stripping unit. After the latter machine reaches the end of its cut, it starts on the second cut, as is indicated in Figure 2. Whether it is advisable to turn around and work back in the opposite direction or to propel down the line of the cut and start the second cut in the same direction as the first was carried, is a question that depends upon conditions, the principal among these being how far ahead the stripping machine is ahead of the loading operations. We will assume, however, that in the normal case it is considered more economical to move the machine back, which can be done in short order when mounted on caterpillars, thus obviating the necessity of rehandling a large amount of material. As is shown in section 2, the stripping dragline now begins the second cut and throws the overburden from it into the old excavation. It rehandles the spoil pile from the first cut in the same manner, thus preventing a second rehandling. This procedure, of course, could be suited to local conditions.

In many cases the advantage of a wide reach is of paramount importance. A not uncommon procedure where the deposit is not of great depth and where the machine can strip and load from the same position is as follows: Let us assume an overburden of five feet in depth and a gravel deposit of 15 feet. Let us also assume that the machine selected for this purpose carries a 100 foot boom and a 3½ cubic yard bucket. From Figure 3, we will see that the dragline is set with its pivotal center about 105 feet, we will say, from the edge of the previous cut to the left.

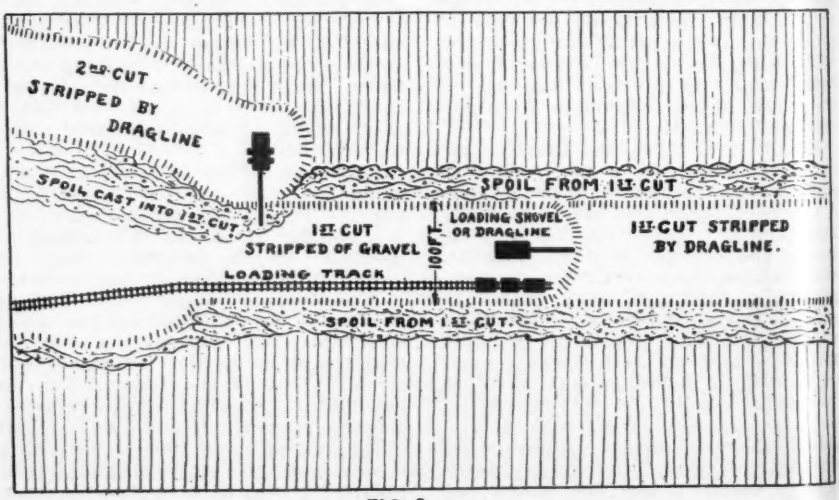
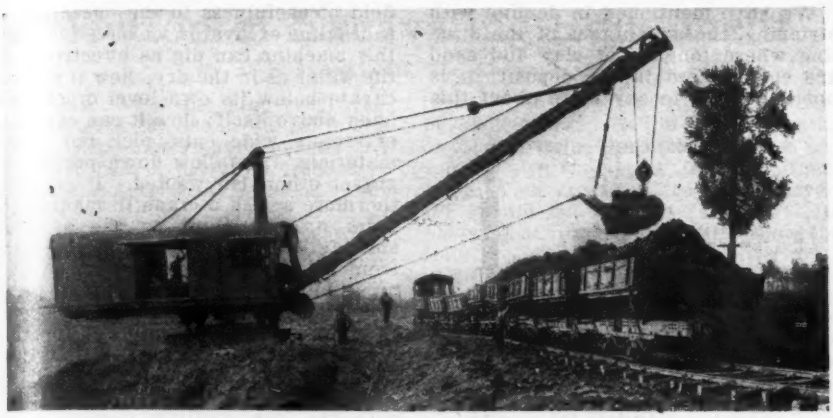


FIG. 2.



Good Loading—No Spilling and Cars Loaded to Capacity

This would enable it to load cars on a track set at the same distance from the center of the machine on the opposite side, allowing for a road-bed for the loading track. The dragline could consequently, carry a cut 205 feet in width. It would be the tendency of the operator to strip the material at the far edge of the cut away from the loading track while waiting for cars and to load the gravel from that part of the cut first, to provide plenty of space for dumping the waste. When the dragline arrives at the end of the cut it is turned around and carries a return cut parallel and to the right of the proceeding cut; as shown in Figure 4, it is set at the same distance from the edge of the cut, namely, 105 feet, and loads the cars on the same loading track. Any good operator can throw his bucket to a considerable distance beyond the end of the boom. It is therefore possible to carry a wider cut on the return. We have assumed that this cut is 220 feet wide, which is conservative. As the dragline advances, which is usually in jumps of about 40 feet, the old track is picked up in sections and thrown in position for the next cut to the right.

It will be seen from the preceding that it is thus possible to carry a cut about 425 feet wide or more, with only one shifting of the loading track. A dragline with a 60-foot boom could follow the same procedure and carry a cut 240 feet wide, with only one shifting of the loading track.

The simplicity of this operation is at once obvious and illustrates in a striking manner the advantages of the larger machine.

These are but a few of the more striking advantages of the dragline excavator for stripping. Its qualifications for loading the gravel itself are as strong.

The Advantages of the Dragline in Loading the Gravel

The first and most obvious that should be mentioned is the case of flooded pits. Many a plant has had its profit sapped and its shipments curtailed by the fact that a heavy rainfall or a periodical flood has buried its tracks and put its shovels and other apparatus out of action. The cost of operating pumps is not one that ordinarily results in an entry on the profit side of the ledger. With the dragline excavator, the operator can with propriety scoff at such occurrences. His machine on the ground level can dig the gravel as effectively under water as on the dry land, no matter what the depth may be, at a cost which in many instances is considerably less per cubic yard handled, than with a shovel. Furthermore, the operator does not have to face the nuisance of tracks buried in mud and water, locomotives derailed, and expensive pumping equipment. He can rest assured that his shipments will not be stopped by circumstances beyond his control.

It is well to mention here that the dragline is similarly effective in digging gravel from the beds of streams and rivers by operation from the bank. This has been done in many instances with unqualified success.

We have mentioned in dealing with stripping, the advantages of the dragline where tongues of clay and sand are encountered in the deposit; it is not necessary to say more about this important operating advantage at this time.

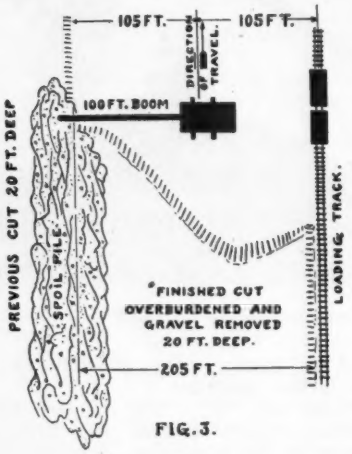


FIG. 3.

In the small and medium sized plant of a permanent or semi-permanent nature, where the dragline with its long boom can deposit into a hopper over a loading track or at a considerable height over the screens, it is obvious that the necessity of belt conveyors with the attendant power unit, can be eliminated. In such instances this machine has frequently realized substantial savings.

The Versatility of the Dragline Excavator

Any statement of the adaptability of this remarkable tool would not be complete without an observation relative to its astonishing versatility. Undoubtedly, no more all-round flexible tool has yet been produced. Most draglines are built so that they may readily be converted into a shovel, clamshell excavator, or a crane, by the simple substitution of the proper boom equipment, a job which usually can be done without trouble in the field. This greatly widens the field of usefulness to the operator. As a dragline excavator, we have seen how this machine can dig as effectively on the water as in the dry; how it can excavate below its own level or carry a bank above itself; how it can excavate extremely wide cuts, pick out waste materials, and follow down pockets of gravel otherwise wasted. It can furthermore act as a crane in making repairs on the plant or the screens, shifting loading track on spotting cars from its digging position. It can pull up stumps and clear ground in its path, thus doing away with the necessity of extra labor and equipment for this purpose. Its bucket is so well controlled that it can load cars with little wastage from spill, and incidentally, with far less spotting necessary, in order to bring the cars under the load.

The dragline, however, is not a cure for all pit problems. There are many installations where other types of equipment are more economical and profitable but it is hard to visualize any other type of machine which is more generally adaptable to problems ordinarily encountered.

J. H. Bartlett of Louisville made a visit recently to Middlesboro, Ky., and according to his statement, there is a possibility of a $1,500,000 cement plant being established near Middlesboro. He said also that the present concern has only a short time lease and option on the property, so an early statement is looked for.

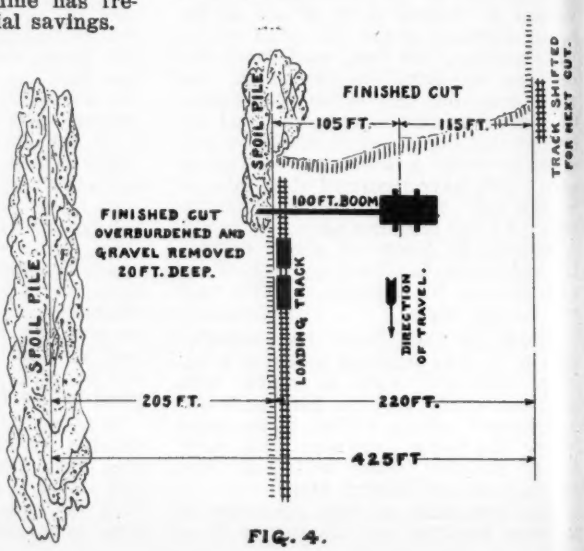


FIG. 4.

Selection of Excavating Equipment

By A. E. HOLCOMB, The Koehring Co.

The selection of the proper excavating equipment for use in his pit is one of the most important problems the pit owner has to solve; it frequently means the difference between profit and loss.

No one type of machine can be broadly said to be best suited to gravel pit work. Whether the material is to be loaded in trucks or cars, the location of the switch track, the amount of the over-burden, whether the conditions are such that the over-burden could be wasted or whether it would have to be hauled away, whether the pit will be wet or dry, and the daily tonnage required—all of these things must be considered when declining upon the type

A. E. Holcomb.

of machine that would be best adapted to the work.

A shovel is faster and will load more tons of material in a given length of time than will the same size of clamshell crane or dragline excavator. Where the work is such that the switch track or loading point would best come in on a level with the bottom of the pit, a shovel should be used, as the big distinguishing feature of the shovel is its adaptability to bank work. If the switch track or loading point can best be located on a level with the top of the pit, either a clamshell crane or dragline excavator should be used, as the shovel is not well adapted for digging below itself.

Either the clamshell crane or dragline excavator can of course be used when necessary as a crane for lifting loads, but such necessity would occur so seldom that this advantage over a shovel would hardly be worth considering.

A dragline excavator will remove the over-burden faster and better than the clamshell, particularly if it is a hard dry clay or if the material is partially cemented; on the other hand, the dragline is not well adapted to the loading out of materials unless the pit is relatively shallow, as the dragline will not dig advantageously to a depth greater than approximately one-third the length of the boom. Furthermore, because of the swing of the bucket in dumping, the operator has to be more careful and cannot load out a given tonnage as quickly with a dragline as he can with the clamshell. On the other hand, the dragline excavator would not have to be moved as frequently and would not lose as much time from that caunse as would the clamshell machine. For relatively shallow work, either the dragline excavator or clamshell crane could be used for loading purposes, but when the pit is deep, the clamshell must be used.

The clamshell has the advantage also of being easier on the machine, entailing less loss of time due to wear of cables and other parts.

Where the sand and gravel is to be removed from a creek bed or a pit where the bottom is under water, the material can be taken out with either a dragline excavator or clamshell crane, starting operations at the upstream side of the pit, and working down-stream, shifting the tracks back as the pit is widened out by the removal of material.

Where the over-burden is relatively deep and would have to be hauled away, the shovel of course would be the better machine to use; on the other hand, after the over-burden is

removed, it would be better to use a clamshell crane or dragline excavator for taking out the sand and gravel. This brings up the point of the advantage of combination machines.

Where the over-burden is relatively hard, the pit, after being stripped, is relatively deep, and the loading point is at the top; the use of a dragline excavator for stripping, changing to a clamshell bucket for loading out the sand and gravel would make a good combination.

Where the over-burden is relatively hard, and is to be wasted at the side in the hole left by the removal of sand and gravel already taken out, and where the loading point is at the bottom of the pit, a dragline excavator for the stripping, changing to the shovel boom and dipper for loading, would be very effective.

Where the over-burden is deep and shovel boom and dipper for loading, has to be hauled away and the material is to be loaded out at the top of the pit, a shovel for handling the over-burden, changing to the crane boom and clamshell bucket for loading purposes, would make a very satisfactory mechanical combination.

The relative advantages of the different types of machines set forth above are briefly summarized in the following diagram:

EXCAVATING EQUIPMENT FOR GRAVEL PIT

- **Shovel**
  - Faster than crane or dragline excavator.
  - Specially adapted to bank excavation.
  - Not suitable for pit work where excavation is below level of machine.
- **Clamshell Crane**
  - Best suited to deep pit where loading point is at top.
  - Not adapted to bank work.
  - Faster than dragline excavator for loading purposes.
  - Clamshell crane subject to less wear and fewer replacements than dragline.
- **Dragline Excavator**
  - Best suited to stripping clay overburden or to loading out materials from a creek bed or relatively shallow pit.
  - Not adapted to bank work nor to deep pit work.
- **Combination Machines**
  - Dragline-clamshell crane — Stripping over burden with dragline and loading from deep pit with clamshell crane.
  - Dragline-shovel — Stripping over-burden with dragline and loading out from bank with shovel.
  - Shovel-clamshell crane — Stripping and loading over-burden with shovel and loading from deep pit with clamshell crane.

Where the loading point is at the top of the pit, a very good method that can usually be employed is to start at one side, removing to a given width, with clamshell or dragline the over-burden on a strip clear cross the pit, side-casting the material. The width of the strip would depend upon the depth of the pit and upon the depth and angle of repose of the over-burden. Next, the sand and gravel that has been stripped would be removed and loaded out in trucks or cars, according to conditions of sale, quantity to be handled and location of screening plant.

Where the daily tonnage is sufficient to warrant it, two machines could be used, one digging out the sand and gravel and the other following, removing the over-burden from the adjoining strip and casting it in where the sand and gravel has just been removed.

Where the over-burden is not great, however, a sufficient amount can be stripped through the slack season to take care of the busy season's requirements, thus obviating the necessity of a separate machine for stripping purposes.

Just what would be the most economical operation and type of machine to use would depend entirely upon the particular case in question and would have to be decided by the amount of over-burden, the daily tonnage required and the contour and layout of the pit with accompanying natural conditions.

The Scioto Township Limestone Company, Cove, Ohio (Jackson County) has been incorporated for $10,000; John W. Stephenson, George W. Weber, C. R. Berton, Roy W. Perry and J. C. Gahm.

Interesting Moment in a "Shot" at Frazier, W. Va.

Gelatin Dynamite in Quarrying

By CHARLES S. HURTER, Technical Representative,
E. I. du Pont de Nemours & Company.

Gelatin dynamite, commonly called simply gelatin, is a dense, soft and plastic explosive. It is as nearly waterproof as it is possible to make a high explosive in the lower grades and in the strengths of 60 per cent and higher it can be considered as actually waterproof. The explosive base is a waterproof jelly made by adding a small amount of one of the soluble varieties of nitrocellulose to nitroglycerin.

The use of nitroglycerin in this jelly form gives gelatin dynamites a very important safety advantage over the dynamites whose nitroglycerin is in the liquid form, as the jelly is not so sensitive to shocks and friction in handling and loading as is the liquid nitroglycerin. It is possible to spread dynamite out in such thin layers that an explosion cannot carry through these layers. In seamy rock, particularly where the holes are sprung, the more granular or pulpy types of high explosives sometimes work their way into these cracks and seams and the dynamite lost in this way does not explode with the main charge. If this dynamite is afterwards struck by a pick, shovel, drill or some later operation in the handling of the rock, it may explode and cause injury to some of the workmen. As gelatin is a plastic explosive with about the same cohesiveness as putty it will not run into cracks and seams and its use is a sure preventative of accidents from this cause. It is therefore my recommendation that nothing but gelatin be used for loading sprung holes.

In the handling of explosives in loading, the granular or pulpy dynamites are often spilled on the ground around the holes, creating a source of danger. Here again the plastic nature of gelatin enables it to be handled without crumbling and spilling on the ground during the loading operation. Sometimes the explosive is taken from the cartridge to insure better packing in the bore hole with a consequent

elimination of air spaces and more effective work from the dynamite. This is one condition in particular where gelatin has a big advantage over all other types of explosives. The wrapper may be removed and the contents dropped in the bore hole in one piece, or a wooden knife can be made out of a piece of board or old pick handle and the gelatin cut into chunks of the desired size. These can be dropped into the hole without loss of explosive and without the attendant danger from explosive scattered on the ground.

In the loading of large blasts it is often necessary for the explosive to remain in contact with water for considerable lengths of time. Gelatin is the only explosive that can be loaded under these conditions with the surety of exploding with its full effective force when the time comes to fire the blast. Even in the lower grades it can be used under water with assurance and with the 60 per cent and higher strengths, the paper can be removed and the explosive loaded under water the same as in dry work.

Gelatin has a density about ten to twelve per cent greater than that of ordinary dynamite. This characteristic combined with its plasticity insures a solid compact load. This is particularly important where there is no favorable slip at the bottom of the face, where there is a heavy toe, or where any condition renders the blast, particularly the bottom of the face, heavy or tight, making the maintenance of the floor grade difficult. Oftentimes an effective load can be made by using gelatin at the bottom and extending the charge up the bore hole with another explosive for fragmentation.

In hard tough rock, however, gelatin will also give the best fragmentation because under good confinement gelatin has a quickness about ten per cent greater than the corresponding strength of a straight nitroglycerin dynamite. This feature, together with concentration of the load made possible by its density and plasticity, renders gelatin the most effective high explosive for blasting hard tough rock where good fragmentation is desired.

One purpose for which gelatin must not be used is mudcapping. Unless properly confined, gelatin is very slow in its action and consequently for mudcapping it is about the most inefficient explosive there is. Straight nitroglycerin dynamite which maintains its quickness under all conditions, provided it is dry, is the most effective explosive for mudcaps, sand blasts and like unconfined shots.

I should recommend that mudcaps be used only where absolutely necessary for quick action, as when a steam shovel is held up by the uncovering of a boulder which must be broken up before it can be handled. In such an emergency, mudcapping saves enough time to make it economical. Ordinarily, however, holes should be drilled in boulders for the charge, for by blasting them in this manner from ninety to ninety-five per cent of the dynamite used for breaking them by mudcapping can be saved. For blasting boulders by blockholes, particularly where very small charges are necessary, gelatin again is the easiest explosive to handle and the most economical. On account of its plastic consistency, small pieces can be cut from the cartridges and these pieces loaded in the hole without loss by spilling and its attendant danger. A hole can be punched in the gelatin in the bore hole, the cap inserted and the hole tamped up. Here as in primary blasting the extra quickness of gelatin under confinement will result in breaking the rock into smaller fragments. This naturally will be more noticeable in blasting large boulders than small ones.

In view of these several advantages of gelatin all quarrymen should give serious consideration to the possible use of gelatin in their operations, if they have not already done so.

An injunction to restrain the Tuckahoe Stone Corporation from "destroying the natural beauties" of its Tuckahoe property was asked of Supreme Court Justice in White Plains, N. Y., by Harris F. MacNeish of Tuckahoe, professor of mathematics at the College of the City of New York. The injunction was allowed only pending trial of the issues.

The defendant states that the property represents an investment of $50,000 in a legitimate business enterprise and declares that it should not be prevented from conducting its business.

The Gomez, Lang, Pena Brothers, Inc., of Barre, Vt.; to quarry, sell and manufacture granite, marble and other stones; capital $10,000; incorporators, Joseph Pena of Barre, Ellis J. Gomez of New York, and Alland Fry of Barre.

Cheaper and Simpler Crushing Plants

By RAY F. SCHNEIDER, Sales Engineer, Williams Patent Crusher and Pulverizer Company.

Judging from the success of hinged hammer crusher installations made within the last two or three years it is quite evident that crushed stone operators have long overlooked an opportunity of producing their product with smaller investment in equipment and at lower cost per ton.

Precedent and a hesitancy to use new methods have to some extent hindered the adoption of hammer crushers by crushed stone operators; however, the advantages in dollars and cents, fully proved by actual performance, are evidence too strong to be overlooked. In fact, the large number of hammer crushers which have been installed are evidence that converts are being made every day. In Kansas City, for example, a Williams Jumbo crusher was installed at the quarry of E. H. Bradbury. Its work crushing 14-inch limestone to macadam in one operation so impressed neighboring quarrymen that two duplicate machines were sold on the strength of the one installation; inquiries indicate that several more plants are interested.

Ray F. Schneider.

The greatest advantage of hinged hammer crushers of course is their unequalled crushing ratio, which makes it possible for the operator in most cases to do all of his crushing with one crusher. Naturally, this ratio varies with the capacity of the plant; the greater the capacity the larger the crusher and the larger the crushing ratio. It is also notable that the crushing ratio of a given capacity is always in perfect harmony with the loading equipment. As an example, a quarry producing 100 tons a day of crushed rock usually hand loads its rock in the quarry. Hence a Williams crusher of this capacity is built to take one-man stone and reduce it to macadam or even agricultural limestone in one operation.

This harmony of loading equipment and crusher prevails clear up to the plant handling 48-inch cube stone, rock of this size being reduced to 1½ inches in one operation by the No. 9 Mammoth crusher. No crusher plant executive can fail to recognize the possibilities of a machine which operates on a 32 to 1 crushing ratio as in this case.

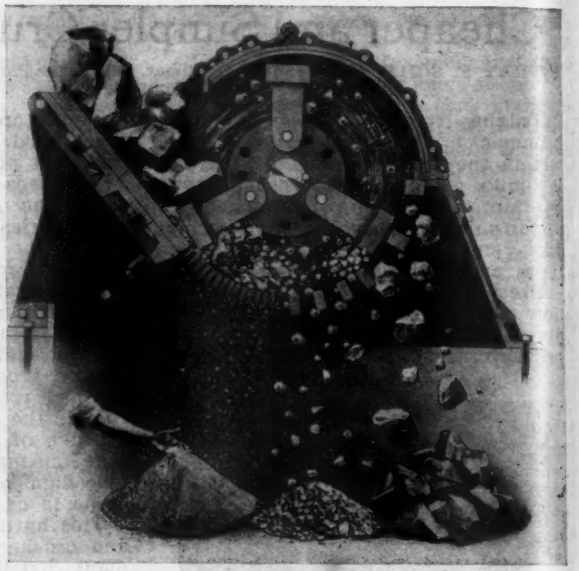
Obviously the cost of equipping a plant using hinged hammer crushers is considerably less than where the method employing a primary and one or two re-crushers is used, as a saving is made not only in the cost of the actual crushing equipment but in such accessories as drives, motors, screens, elevators, conveyors, foundations and larger buildings. In most cases this saving in first cost amounts to 50 per cent or more.

As regards operating cost, installations now in use show much in favor of hinged hammer equipment. Plainly, maintenance is reduced as less equipment is exposed to wear and tear. Power consumption is also lower as less conveying machinery is used for carrying the rock through the successive crushing steps while the frictional load of the bearings of extra crushers, countershafts and the like, are factors no modern engineer can overlook. Less cost for supervision, oiling and similar expenses are also to be considered. One plant reports a saving of 53 per cent in crushing costs since installing a hammer crusher.

Reduced cost of operation is especially noticeable in plants where lim-

ited capital prohibits the purchase of more than one crusher. If a crusher of small crushing ratio is installed, much extra blasting and sledge hammer work in the quarry is necessary. This extra expense can be avoided if a large ratio hammer crusher is installed as it would very likely handle the quarry run rock.

Until just recently considerable misunderstanding has prevailed as to the regulation of "fines" with a hammer crusher. Many operators who have been approached with the purpose of installing hammer type equipment have been under the impression that as it was used so largely for cement plant work it was suitable only for work requiring a large percentage of fine material. It is true that Williams' crushers are now in operation in a large majority of cement plants but this is decidedly in their favor as they were installed primarily because of low operating cost and secondly because they were capable of a wide range of adjustment which permitted the desired large percentage of fine material required in crushing rock for cement.



Showing the Action of a Williams Crusher.

Properly handled the hammer mill can be regulated to deliver an unusually uniform macadam, concrete stone, stone for fluxing and even for kiln burning. It should also be remembered when mentioning cement plants that this branch of the industry is far ahead of the rest of the nonmetallic mineral industry as a whole as regards accuracy of their cost systems, and therefore should be in an excellent position to select equipment where crushing costs are one of the considerations.

Just how Williams' hammer crushers can be adjusted to produce the proper sized finished product is best told by the illustration. As will be seen, three adjustments are possible, first by the use of grates with larger or smaller openings, second by the use of different types and arrangement of hammers, and third and most important by raising or lowering the adjustable breaker plate in the front end. All of these adjustments as a combination give a wider range of regulation than will be found in any other equipment.

Summed up, it is evident that many crushed rock producers will follow in the footsteps of those who have installed hammer equipment and that cheaper and simpler crushing plants employing this equipment will become more numerous within the next few years.

A gravel mining company, known as the Hesperides Mining Company, has started operations just east of Wallace, Calif. Sluice boxes and plates have been installed to catch the gold. When the sand has run through the boxes, it is sold as first grade wash sand. A gravel crusher will soon be installed to make commercial gravel.

With their modern machinery it is possible for six men to handle from 600 to 800 yards of gravel per day, extract 10 cents in gold from each yard of material handled and either load it directly on the cars or into the bins for storage. The company is incorporated; has about 175 stockholders, and the directors are largely men of San Joaquin county. H. B. Paterson of Lodi is president and general manager; H. L. Patterson of Lodi is secretary; F. M. Rice of Stockton, plant superintendent.

Shovel Efficiency Requires More Than Operating Skill

Breakdowns, delays and the general inferiority of a shovel or crane can discount the good work of the most skillful operators. An efficient and dependable machine is as important as a good operator.

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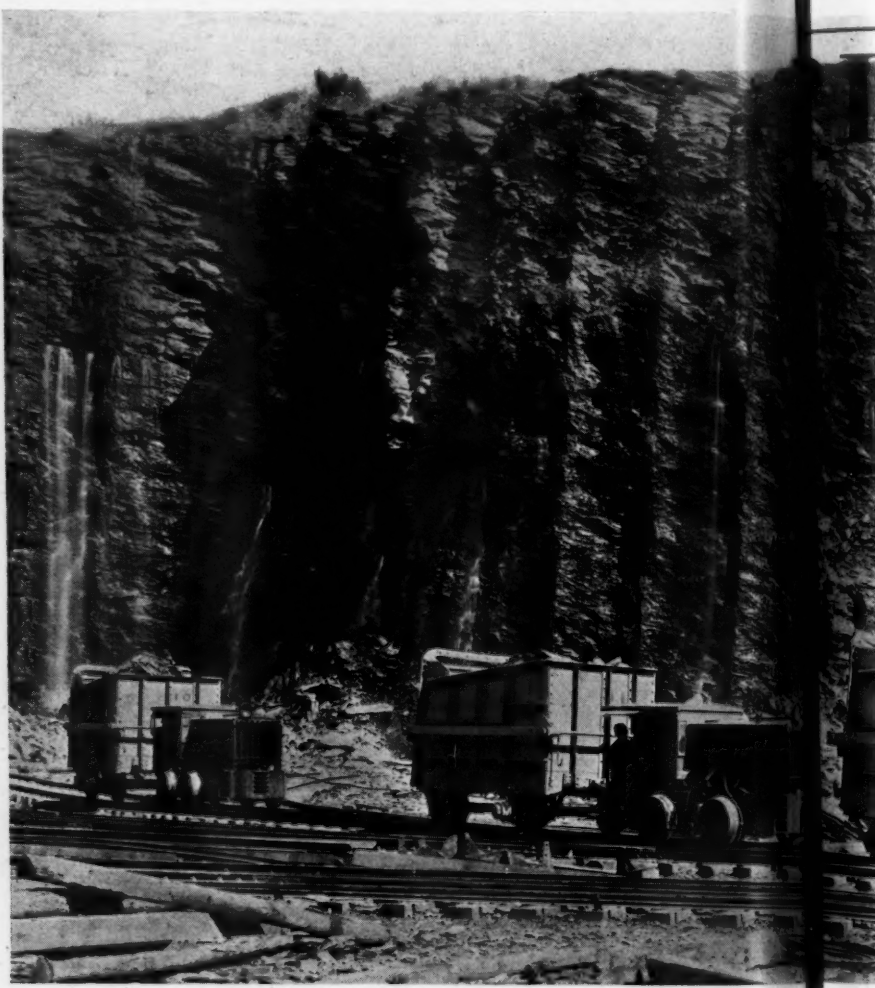


Lawrence Portland Cement Co. End lyn

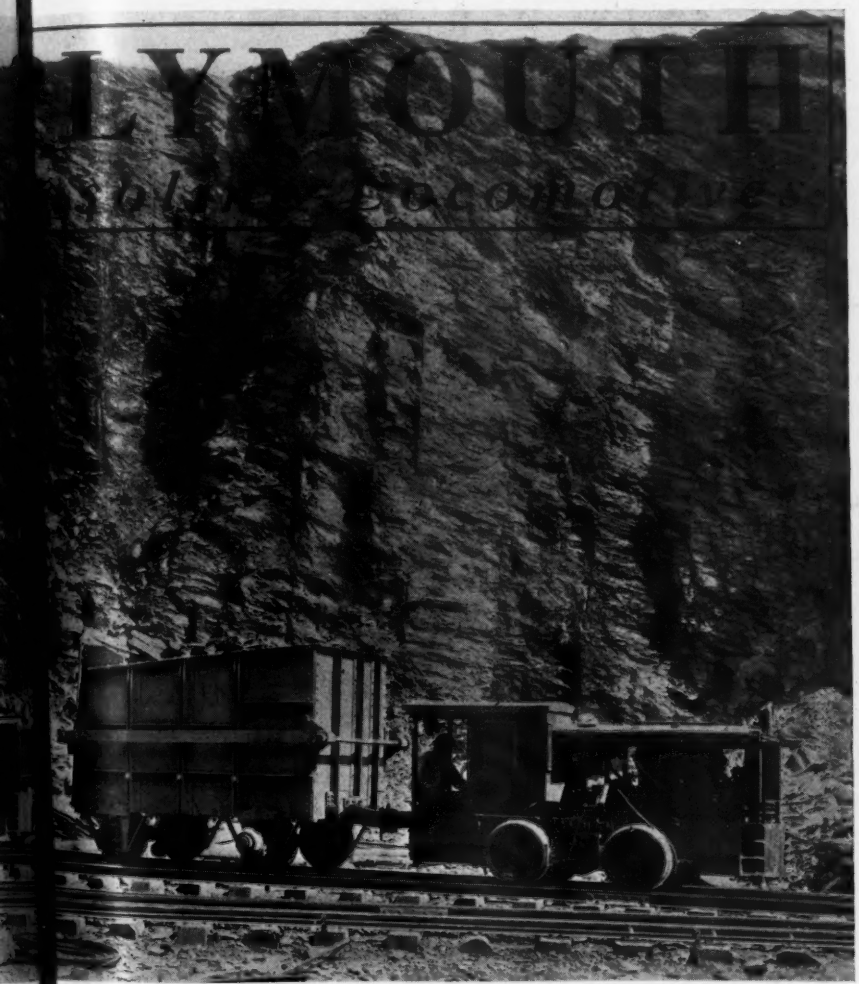
The Lawrence Portland Cement Co. of Siegfried, Pa., man e wel "Dragon" brand of Portland Cement.

In 1921, they bought a Plymouth Gasoline Locomotive. so repeat orders followed until now FOUR Plymouths take care of ge.

Please read the letter in adjoining panel—it is both short an g.

The Plymouth is the most persistent "repeater" of any ha n the It pays to build merit into your product. Ask for literature.

THE FATE-ROOT-HEATH CO., Plym hio



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Plym hio

LAWRENCE PORTLAND CEMENT CO.
302 Broadway, New York.

The Fate-Root-Heath Co.,
Plymouth, Ohio.

Gentlemen: We purchased three 7-ton Plymouth Locomotives for our cement rock quarry at Siegfried, Pa. as the result of our satisfactory experience with one of your 6-ton Locomotives in our limestone quarry at Annville, Pa.

These three locomotives are also working very satisfactorily.

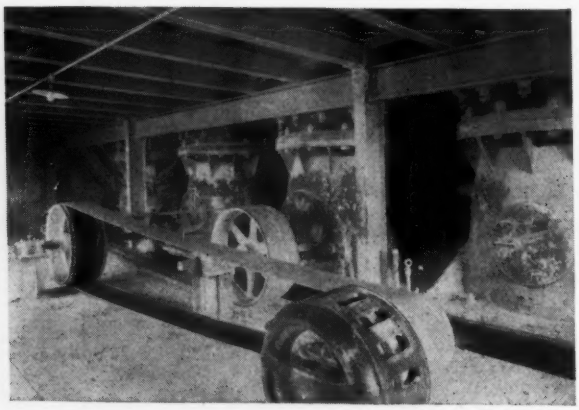
Very truly yours,
(Signed) Jas. S. Van Middlesworth, Sec'y.

Power Selection and Application in Pits And Quarries

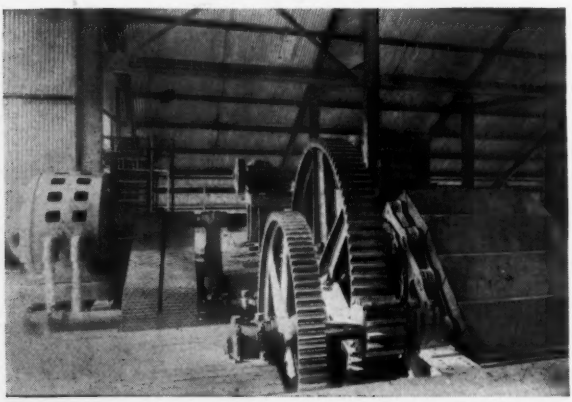
By C. S. LINCOLN, Chief Draftsman, Crushing and Cement Department, Allis-Chalmers Manufacturing Co.

Twenty years ago a very large majority of the rock and gravel crushing and screening plants in the world were driven by means of steam power. At that time the central power station for making and distributing electric power was not as extensively developed as at present and as the crushing plants were usually located several miles from the center of towns, manufacturers were forced at that time to install their own power plants. These were nearly always steam plants consisting of return tubular boilers, feed water heaters and in many cases plain slide valve engines of low efficiency. In the larger and better plants, Corliss engines, either simple or compound, were used. In modern crushing plants, where steam is used, the most efficient engines obtainable should be used, due to the high price of fuel and to help conserve our natural resources.

In the modern rock crushing or gravel crushing plant, electric motor drivers are usually adopted. In some of the larger plants a considerable distance from central power service, steam turbo generators or engine driven generators produce the electric power for transmitting to the various motor driven machines.



A Group of Motor Driven Rejection Crushers.

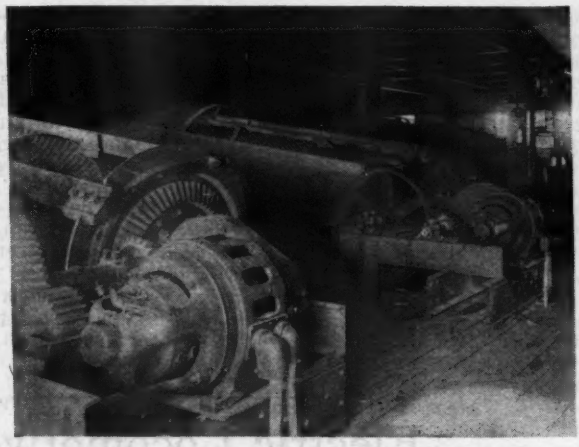


200 H.P. Slip Ring Motor Driving Pan Conveyor.

The plant design and machinery arrangement is influenced to a marked degree by the kind of power used. A steam plant must be driven through a line shaft from which the various machines are driven by belt, chain or rope drives. The line shaft drive necessitates a compact plant with the machines grouped in such a way as to avoid quarter twist belts, quarter turn ropes and bevel gearing as much as possible; this type of apparatus will work well only as long as kept in line and given proper attention. It requires extra care and becomes out of order more quickly than straight belt or chain drives.

The recent extensive use of individual and group drives by means of electric motors makes it possible to lay out rock and gravel

crushing plants based almost entirely on an ideal arrangement as regards the flow of material and operations to be performed. This refers particularly to the mill where the stone is crushed and screened, but great advantages are gained throughout the quarry and pit as well as in the mill, by use of electric motor drive.



Typical Installation of Direct Connected Screen.

The modern direct connected motor driven centrifugal pump whch has almost entirely superseded the steam pump may be located at the most advantageous point to pump the pit quarry free from water or provide an abundance of water for washing gravel, sand or stone. Long exposed steam lines where excessive condensation and consequent loss of power are encountered can be eliminated, by electric driven pumps.

Well drills for drilling blast holes operated with electric motors are becoming more popular, the electric operated shovel for quarry operation is being recognized by an increasing number of quarry operators. The advantages of being able to throw off the switch at quitting time without having to worry about getting up steam in the morning or cleaning boilers and keeping pipes from freezing, are some of the advantages of electric motor drive as applied to this class of quarry equipment.

The cars which bring the material from the quarry or pit to the crushing unit are at present equipped with steam, gas or electric locomotion but where hoisting of individual cars from the pit floor to the crushers is necessary an electric direct connected hoist makes an ideal arrangement. For smaller plants where the investment must be kept down a friction hoist belted to an electric motor or driven from the lineshaft makes a very good arrangement.

The primary crushing units of either the gyratory or jaw type are generally driven by motors through a belt or rope drive. When a rope drive is used between motor and crusher, the English or multiple rope drive is to be preferred as the breaking of a single rope will not ordinarily cause serious delay and may be repaired after workhours. Where belt drives are used between motor and crusher, they should be heavy enough to take care of the peak loads as there are times when these will reach, momentarily, 100 per cent above the motor rating.

Where motors are belt connected to machines, particular care should be exercised to provide belts of proper width and thickness compared with pulley diameters and belt speeds, to permit transmitting the power economically. If a belt is too light, it must be kept exceptionally tight which means a short life and plenty of trouble; if it is liberally designed, it may be run comparatively slack which gives long life, keeps down friction on bearings and consequent loss of power and prevents costly shut-downs.

For motor drives on heavy crushers where wide belts are used, it is often necessary and advisable to use three bearing motors, thus eliminating the excessive overhang of motor shafts and making a unit much more satisfactory in every way. While belt drives will probably be used indefinitely for driving crushers, due to their convenience and ability to absorb shocks, elevators, conveyors, screens and other auxiliary equipment, which operate at low speed, are being directly connected to electric motors by means of spur and worm gear reductions, likewise back geared motors.

For rock crusher service, motors should be selected amply large; the

slip ring type of induction motor is to be preferred as it allows starting under some load, although ordinarily crushers are started empty. It is poor practice to try to start them with fully loaded and very hard on the equipment although it is done in some cases.

In the ordinary crushing plant the material as crushed is delivered to some form of elevator or conveyor and thence discharged into revolving screens. Where electric power is available, the elevator pinion shaft is belted to an electric motor and the revolving screen is driven by a belt from a pulley properly placed on the elevator pinion shaft. This is a form of electric group drive which is in frequent use where two machines must work together, the elevator pinion shaft forming a jackshaft for reducing the high speed of the motor to the comparative slow speed of the screen.

The cuts illustrate a typical line shaft steam driven by plant and a typical electric driven plant of approximately the same size; the photographs show a number of applications of electric power drives to crushers, screens, pan conveyors, elevators and hoists.

Electric Locomotives for Pit and Quarry

By FRANK E. FISHER, Goodman Manufacturing Co.

There are four types of electric locomotives which are used in and about quarries, brick yards, and allied industries and each class of locomotive has its particular field of usefulness. Before the right locomotives can be recommended for a job, there are certain governing factors in each particular installation, which must be considered. These are as follows:

(a) Length of haul.
(b) Amount and direction of grade.
(c) Track gauge and weight of rails.
(d) Clearances on the sides of the track for locomotive, and clearances under trestle or through doors of buildings.
(e) Weight of empty car and type of axle bearings in the car.
(f) Weight of loaded car.
(g) Number of cars to be hauled per trip or total tonnage to be handled daily.
(h) Character of load.
(i) Source of power—Alternating Current or Direct Current.

Trolley Locomotives

With the above information at hand, a locomotive manufacturer is in a position to recommend suitable equipment. If the haul is long and the amount of material to be moved is large, then it is advisable to put in a trolley job for there is then unlimited power behind the locomotive.

This type of locomotive has many advantages for out-door haul. In the first place, it is not subject to temperature. Cold weather does not affect the operation. It does not need an experienced or licensed operator. A man can be taught to run a trolley locomotive in less than a day. When it is standing idle it uses no power and is, therefore, very economical in operation. The parts of the locomotive are usually made heavy and the up-keep cost of a good trolley locomotive under ordinary service, should be less than $75.00 a year. It is fast in operation. The average speed at full drawbar pull of the locomotive is about 8 miles an hour. On light loads the speed will run up as high as 12 to 14 miles an hour. The parts of a trolley locomotive are standardized, so that replacements made necessary by wear or breakage can be secured almost the same day they are ordered. This insures continuous operation.

Reel and Trolley Locomotives

The second type of locomotive is a trolley locomotive equipped with an electric cable reel. The electric cable reel is nothing new and has been used in coal and metal mines for years. It is a piece of apparatus added to a trolley locomotive and provided with all necessary controlling parts, both electrical and mechanical for running a trolley locomotive any distance up to 1,000 feet away from the trolley line itself. This is of particular advantage in quarry

work where the material is hauled any distance from the quarry. The end of the track is constantly shifting and it is quite impossible to run a trolley wire up to the face. Moreover, the blasting of the rock would probably make the use of a trolley wire not only unsatisfactory, but dangerous. It is, therefore, advisable to find some means for getting the locomotive close to the work without the use of a trolley wire. The electric cable reel is so designed that the cable is paid out and taken up without dragging the cable. In coal mine work where the cable is paid out continuously, the average life of the cable is about a year and the cable costs approximately 12c a foot, so that to the figure of $75.00 a year as a maximum annual cost of repairs on a trolley locomotive, must be added the cost of the cable and the up-keep of the reel itself, which is very small. In quarry work it is estimated that the cable would last approximately two years if well taken care of. Therefore, assuming that 800 feet of cable is used at a price of approximately 12c a foot, the annual cost for cable would be about $50.00.

Storage Battery Locomotives

There are certain places where it is impossible or inadvisable to use a trolley wire and in these places it is sometimes to advantage to use a storage battery locomotive. The storage battery locomotive has certain advantages and certain limitations. The main advantage of a storage battery locomotive is the fact that no trolley line is needed, nor is there any use for a cable reel, for the locomotive can go wherever the cars can travel. It requires a little better class of operator than a trolley job, but the average man can be taught to run a battery locomotive in a day or two. The objections to a battery type of locomotive are as follows:

In the first place, the battery is the most expensive part of the locomotive and has a life of from four to five years, depending upon the care given the battery and the abuses to which it is subjected. The average battery will cost in the neighborhood of $2,000 so there is an annual depreciation of from four to five hundred dollars which must be added to the up-keep cost of the locomotive.

It is necessary to have suitable charging equipment for charging the battery and a supply of distilled water. The battery has a limited capacity per charge; therefore, the amount of work that can be done in a day is limited by the size of battery that can be put on a given chassis. The battery will not freeze in cold weather if it is kept fully charged so that there is no danger from this source. The chassis up-keep is about the same as a trolley job so that the total cost per year for up-keep and operating cost of a storage battery job is between five and six hundred dollars.

The speed of a battery locomotive is generally about 3½ to 4 miles an hour at full drawbar pull, as compared to 6½ to 7 miles an hour when a trolley locomotive is used. If the speed of the battery locomotive is increased, then it requires a larger battery to run the locomotive. The storage battery locomotive requires a great deal more attention to lubrication, adjustment of bearings, etc., than does a trolley locomotive. The storage battery locomotive does not require as large a motor generator set or source of power for operation as does the trolley locomotive. For example: a trolley locomotive with 50 Horse Power motor equipment would require under certain operating conditions, about 40 KW capacity of direct current. The battery locomotive for the same drawbar pull would have about a 30 Horse Power motor and would require for charging, only a small set—probably a 15 KW unit would do. The capacity of the charging motor generator set depends upon the number of plates per cell, the type of the battery and the time available for charging. The storage battery locomotive as made at present by several manufacturers, is a dependable piece of apparatus and if selected with care for the given installation, has proven very satisfactory. It should be borne in mind, however, that it is a very much less rugged piece of apparatus than a trolley job and that it is suitable only for certain classes of work. Where the hauls are long or up steep grades and the weight per trip large, it is not advisable to put in a battery job because of the fact that the locomotive carries the power plant "around on its back."

Combination Trolley and Storage Battery Locomotives

Certain installations have conditions which make the combination trolley and storage battery locomotive most

suitable. For example: a pit or a quarry is located at a distance, say of one mile or more from the railroad or other operations of the company to which material must be transported. In addition to this the locomotive must go inside of buildings or under trestles or in places where a cable reel could not be used. For this class of work, a locomotive which can run for the major part of the time on a trolley wire with an unlimited supply of power and for the minor part of the time on a battery without the use of a cable reel or a trolley wire, just suits the requirements.

This combination locomotive can be arranged to charge the battery when the locomotive is running or standing on the trolley line. A smaller battery is needed than in the case of the battery locomotive and the annual upkeep cost is, therefore, very much less. The controller is so arranged that it is impossible to get the battery across the line or to operate the locomotive on both sources of power at the same time. The controller handle is mechanically interlocked so that the high speeds, incident to trolley service cannot be obtained when running on a battery. This is a protection measure used to prevent destruction of the battery due to draws of current which are more than the battery will stand.

The battery box may be made removable so that in case the work is too much for one battery, two sets of cells and battery boxes can be used—one to be charged while the other is in operation. This is, of course, necessary only where the locomotive is double shifted; that is, where it runs twenty-four hours a day. The storage batteries themselves have been brought up to a high state of perfection so that the former high annual cost of a battery due to jar breakage, has been greatly reduced. A few years ago two years' life of a battery was considered very good; now, it is quite common for a battery to last four or five years and even longer.

The electric locomotive of one of the above types, is coming more and more into use around quarries, potteries, cement mills and allied industries. They require less care and attention than either steam or gasoline locomotives and do not require as high-grade an operator as either of these types. There is no water to freeze either in the radiator or in the boiler; it is not necessary to keep up steam during stand-by periods; there is no gasoline to store or explode; there are no clutches to slip or get out of order; they are simple pieces of electric apparatus built in such a rugged fashion that they are almost fool-proof.

Any of the above types of locomotives are built in sizes from 1 to 50-tons, standard sizes being as follows: 1- 3- 4- 5- 6- 7- 8- 10- 13- 15- 20- 25- 35- 40- and 50-tons. They can be arranged to operate on track gauges from 16" to standard, i. e., 56½" gauge.

For industrial and quarry work, gauges are usually 24, 36 or 42", but there are a large number of installations where odd gauges such as 19, 27, 31", etc. have been installed for animal haulage and for these odd gauges, an electric locomotive is available.

It costs the purchaser nothing to have one of the manufacturers of electric locomotives, make a survey of his problem and give him the facts regarding not only the most suitable type of locomotive for the work in hand, but also tell him whether he can save money or not by its use. There are many places where a gasoline or steam locomotive is more suitable than an electric unit but the majority of haulage problems can be most economically solved by the use of electrical equipment. With the increasing number of water power plants and large public service companies spreading their net work of power over large areas, the cost of purchased power in the form of electricity has been greatly reduced. The considerations which led to the selection of a locomotive five years ago, must be revised today and before purchasing haulage apparatus of any kind, time is well spent in investigating electrical equipment.

It is reported that the San Joaquin Portland Cement Company will commence the construction of a cement plant near Three Rivers, Calif. The exploration work has been done by means of core drilling and holes from 266 to 517 feet deep have been drilled, and the engineer in charge of this work has stated that in one small portion of the territory there is enough lime to supply the proposed plant for a period of eight years.

Hammer and Single Roll Crushers

By CLINTON S. DARLING, Pennsylvania Crusher Co.

To begin with, let us be frank in accepting the fact that there is no "universal" crusher. Neither jaw, gyratory, single roller, hammer crusher nor any other type of crusher can be used with equal satisfaction under all conditions of crushing. There are, to be sure, many places where two or more of these types can be used with almost equal satisfaction, and there are engineers and plant operators who would strongly champion one type over another under any certain given conditions. Each, however, has its limitations, which must be recognized.

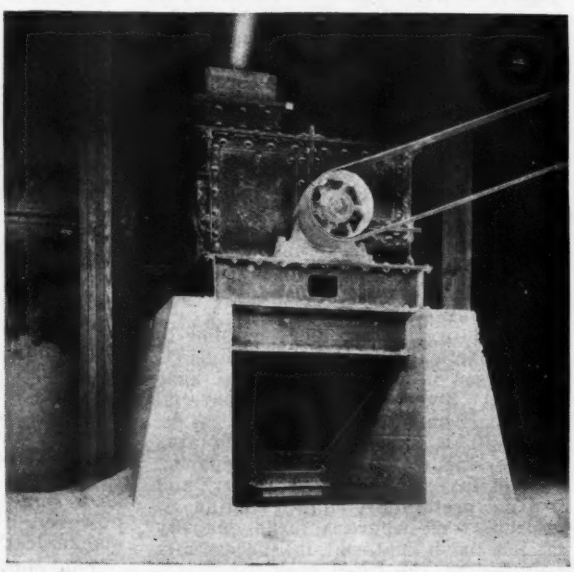
It is necessary to recognize also that no two crushing operations are exactly alike. Variations in the hardness, friability and other qualities of the structure of the particular stone, together with similar variations in the size of feed and the size of product required together with the capacity needed, make each crushing problem a subject for individual study before the most suitable crusher, both as to type and to size of the particular type selected, can be recommended.

I have been asked to write about the possibilities and the limitations of hammer crushers and single roll crushers. Both of these have wide uses in the quarry industries, though as indicated above each type has its limitations which must be recognized.

Probably the first point to be remembered about a hammer crusher is that it is capable of a larger ratio of reduction than any of the other types of primary or secondary crushers. It is quite common for cement plants to reduce in a single operation hard limestone running up to 12 and 15 inches in size, and often considerably larger, to a product that is ¾ inch and under in size. This is a ratio of 15 to 20 to 1, whereas other types of crushers are seldom expected to reduce more than 6 or 8 to 1.

I referred just now to the hammer crusher as a primary crusher, for in gypsum plants, agricultural limestone plants, and other places where hand loading is used—and under favorable conditions of stone there are even places where steam shovel feed can be handled—the hammer crusher is successfully used as a primary, usually combining both primary and secondary in one operation. As a general rule, however, the hammer crusher is a secondary crusher for handling material not over 24 inches in size.

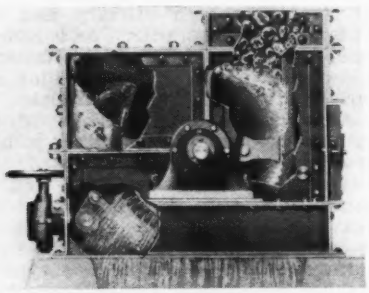
Another point to remember with the hammer crusher is that it is a high speed machine running from 720 to 1,400 R.P.M. in various sizes, and because of the terrific impact of the heavy rotor operating at this speed there is a tendency to crush the stone quite fine. As a result, this type of crusher produces a larger percentage of fines than any other type. For cement plant, gypsum, agricultural limestone, burned lime for hydrating and other similar uses this is a very distinct advantage, but for commercial stone purposes it is often a disadvantage. It is true that by varying the number and weight of hammers,



Small Hammer Mill Installation.

the spacing of the grate bars, the distance of the hammers from the breaker plate and grate bars and other features it is possible to vary within a wide range the size of product from a hammer crusher, but the fact still remains that the percentage of fines is usually too high for the most economical production of commercial stone sizes.

It would not be possible for the cement plants of this country to operate on as economical a basis in the



Principle of Pennsylvania Hammer Mill.

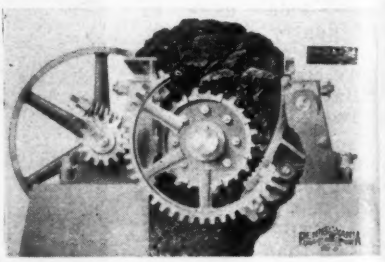
raw crushing departments as is now the case if there were no hammer crushers to reduce the limestone and shale to a size suitable for the preliminary grinding apparatus, which usually means from ½ to 1 inch. The tendency in modern cement plant design is to include a single large primary crusher, of the jaw, gyratory, or single roll type, followed by a single large hammer crusher of sturdy construction. These two machines are counted on to crush every pound of the rock that goes into the cement, and no spare units are provided. This means that these machines must be built to stand exceedingly severe service, and the hammer crusher because of its speed must withstand this severe service without breakdowns and without excessive wear.

The ability of a hammer crusher to make particularly fine reductions is capitalized in the production of agricultural limestone, where material ranging from 20 to 100 mesh is desired. This same fine crushing ability is made use of in preparing burned lump lime for hydrators, and in the preliminary fine grinding of gypsum rock where a large quantity of 100 mesh material is successfully obtained on the dried rock.

For this finer crushing special types of hammers are frequently used and often a machine where the method of crushing is somewhat different from that of the regular hammer crusher is employed. This emphasizes the fact that each crushing operation is a subject for individual study, with the proper solution to be arrived at only after careful consideration of experienced engineers.

Hammer crushers are widely used in another field outside of the quarry industries. This use is the crushing of coal for coking purposes. In a coke plant the coal must be reduced to a size most of which will pass a ⅛-inch opening. The usual by-product specification calls for 85 per cent of the product of the hammer crusher to pass a ⅛-inch opening. Chemicals and many other materials are also reduced in hammer crushers.

Like hammer crushers, the single roll crusher finds its greatest use in the quarry industries in cement, lime and gypsum plants rather than in commercial stone or gravel plants. The large single roll used as a primary crusher has found considerable use in cement plants for reducing steam shovel feed limestone down to 6 or 8 inches in size, and there are also commercial stone plants where single roll primary crushers are reducing the quarry run stone. On the harder stones such as granite and

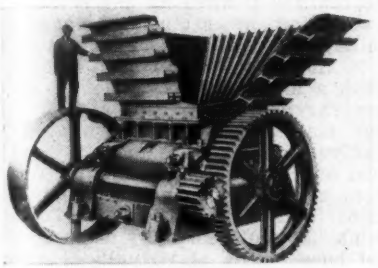


Principle of Pennsylvania Roll.

trap, the single roll can not be recommended as an economical crusher because these harder stones have a tendency to ride on the top of the roll and cause considerable wear due to the abrasion of such rock which is fairly high in silica. On such stone as a single roll crusher is suited for, however, it is a very satisfactory and economical primary crusher.

The more common size of primary crusher has a roll 36 inches in diame-

ter and 60 inches long, and this size of roll will handle anything fed to it by a 3-yard dipper of a steam shovel. Such a crusher has been operating satisfactorily at the flux stone quarries of the Bethlehem Steel Company near Harrisburg, a dozen years. Such a crusher usually has a capacity far greater than that required. This is due to the fact that it must be of the dimensions indicated in order



Cut Away View of Large Roll.

to take the size of feed which goes to it.

Unlike the jaw and gyratory types of primary crushers, the single roll does not need an attendent constantly at the machine. It is practically a self feeding type of crusher and no matter how much rock may be dumped into the hopper on top of the roll the roll can be started up and counted on to pass this material without bridging. If, as infrequently happens, a certain combination of rocks does form a bridge across the hopper, the dumping in of additional rock on the roll will usually displace the offending pieces and break the bridge without any special effort on the part of an attendent.

This same advantage of less labor required makes the single roll a very desirable crusher when used in a smaller size for crushing run of mine gypsum rock as a primary crusher. The softer gypsum rock is very readily reduced by the single roll, and this type of crusher is becoming popular with gypsum plant operators. A characteristic of the single roll which is often in its favor is its ability to crush to a given size and produce a minimum of fines in the product. This is due to the classifying action of the roll, which as it rotates at a comparatively slow speed—20 to 50 R. P. M.—agitates the material in the hopper and permits the finer material to shake down between the roll and the breaker plate without crushing while the coarser material passes between the two as rapidly as it is crushed without excessive reduction.

When used for crushing quarry run or run of mine limestone or gypsum or large lumps of burned lime from the kiln, the roll is provided with teeth varying usually from 2 to 6 inches in height depending on the material fed to it and the fineness of crushing desired. Usually there are teeth of two different heights on the roll, the larger ones being intended to sledge the larger pieces of rock which may reach the roll too large to come into the throat of the machine. This sledging action will reduce these larger pieces until they are of size suitable to be gripped between the roll and the breaker plate and from that point on the pieces are reduced and passed through the machine very rapidly.

When finer reductions are required a single roll provided with flutes running the entire length of the roll parallel with the axis has been found to operate very satisfactorily. One installation I recall is reducing Pennsylvania limestone from 4 to 5 inches, the product of a 7½ gyratory down to about ¾ inch. There is a large demand at certain times of the year for this size of product for road work in Pennsylvania, and the single roll produces it with a minimum of fines which otherwise would have to be screened out and thrown away.

As with hammer crusher, the single roll has a large field of usefulness in coal crushing for reducing run of mine coal to stoker sizes, and it is largely used in power plants, central stations, coal mines and other places for this purpose. Chemicals and other materials are also reduced in single roll crushers.

The Daugherty Sand and Gravel Co., Ardmore, Okla. has been incorporated for $25,000. Incorporators: E. E. Holmes, V. L. Gray, Ardmore, J. C. Skerl, Wilson, Okla.

Orleans Sand and Gravel Corp., Buffalo; $100,000; R. C. Parsons, E. W. and J. F. Sutton. (Attorney, W. H. Hickey, Buffalo.)

The Schumacher Stone Company, Pandora, Ohio; capital $18,000. Fanny Schumacher, Amos Schumacher, C. C. Hilty, A. S. Brauen, Elias Schumacher.

Economical Transportation in Pit and Quarry

By H. R. SYKES,
Sales Manager, The Fate-Root-Heath Co., Plymouth, Ohio.

Right or wrong—economic or wasteful—how prone all we mortals are to travel in the same paths, in the same route—just because that is the way we have always done a certain thing or perhaps the way Dad or Uncle did it before us. No matter whether it be some office routine, drilling a blasting hole or transporting materials—some other fellow may be doing it easier, faster or cheaper.

Quite often we may have had the very same idea but we could not bring ourselves to the point of trying the experiment because, to be honest, we thought we could not stand the jar of getting out of the old familiar path.

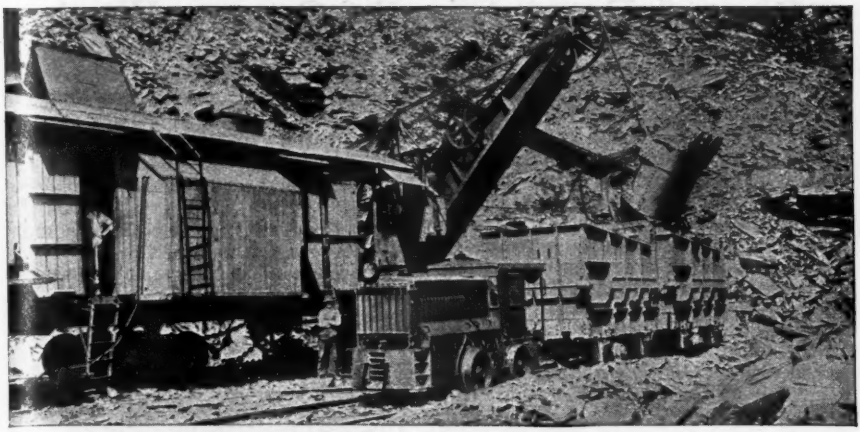
Again, oftentimes in our haste we do not take the time to think out a better and different way. One of the biggest little investments any business or executive can make is the small expense of a week or two away from his job seeing how his competitors and co-workers are doing the very thing he is doing—although everyone has his "old familiar paths."

In the transportation of materials, as a rule one of the most costly operations in most any field of activity in which materials have to be moved, it is indeed remarkable how much inefficient or expensive handling can be found even among some of the otherwise best regulated institutions. To many of us it would be inconceivable that one of our competitors would be using regularly 3, 4 or 6 men to push dump cars when we are using horses or mules to do it, but nevertheless it is true. The deeper the rut a man gets into a habit of traveling the less he realizes it until he has some rude awakening by seeing someone else sailing along on a nice, smooth course.

If that man using, say, 4 men to push a dump car at a cost of $15.00 per car per day should actually see one man and a little gasoline locomotive doing that same work at a cost of $5.00 or $6.00, including operation, maintenance, interest on investment and depreciation, one would think he would certainly wake up and get busy. Still, at virtually the same cost this same small gasoline locomotive can be used to handle the work done by several horses and men at a cost of from $20.00 to $30.00 per day, although many have never stopped to think that possible. It is being done, however, all over the country and the cost of the locomotive saved maybe in less than the first six months of its use—effecting an earning or dividend at the rate of 200 per cent per year on that particular investment. A situation pretty hard to duplicate in any other operation, it must be agreed.

It can be pretty safely stated that gasoline power, or the internal combustion engine, in portable or movable units, even within certain quite lib-

A Gasoline Locomotive Hauling Rock from Quarry.



The Gasoline Locomotive Furnishes Reliable Haulage for the Big Quarry Cars.

eral limits, is by far the cheapest power today—steam or electricity being, of course, that with which it is compared. Like all other ideas of importance, however, a certain process of evolution must precede its general adoption, but that has been taking place for some time although in certain fields is just getting started. Certain steam railroads are at the present time getting ready to use electric locomotives in place of steam ones because they are cheaper to operate and maintain, but electric interurban lines that are going defunct all over the country are being rejuvenated and put on a paying basis by the use of gasoline propelled cars. Why? Because they can be operated and maintained at from one-half to one-fourth the cost of electric operated cars. Even now steam railroads are using more or less small gasoline locomotives to do light switching work as well as in some of their private undertakings, such as in their quarries and around tie treating plants. Coal mines commonly use gasoline locomotives for outdoor or surface haulage, notwithstanding they could use steam locomotives, which they have in the past, and burn coal produced at bare cost. Some of the largest electric power generating plants in the country are using gasoline locomotives for handling their coal and ashes when one would naturally expect they would use trolley or storage battery outfits utilizing the current they produce. The only answer to the foregoing is that gasoline locomotives are cheaper to buy, operate and maintain.

In transporting materials in pits and quarries where gravity handling cannot be employed, gasoline power is in every way as applicable as in the above cases and even more so, as the daily radius of operation is virtually unlimited because one supply of gasoline and water is usually sufficient for the day and it is not necessary to stay close to the coal pile or the water supply as with steam dinkies, nor close to the charging unit as with storage battery outfits. This is true whether the haul be short or long although the longer the haul the lower the cost per ton mile.

A gasoline locomotive is virtually a self-contained unit and with only a small amount of daily attention is regularly ready for daily operation. It is not dependent upon the presence of any one particular person such as a steam engineer or a skilled battery attendant and not subject to the constant daily attention such as the daily charging of batteries. This type of locomotive is demonstrating its worth by steady operation through the Winter in the far, cold North as well as the extreme heat of the tropical midsummer, with far less discomfort to operator and attendant. It has been thoroughly tried and demonstrated alongside of other types of haulage units for the last decade and more, with such evidence in its favor as the other types discarded by many owners using all the way from 6 to 25 units.

Shovel Economies in Quarry Work

By A. C. VICARY, Erie Steam Shovel Company.

It seems as if some quarrymen have not yet gone at the question of steam shovel rock-loading costs by obtaining all the actual figures which are available but are assuming some figures for shovel loading which are higher than actually obtained.

It will probably prove a valuable service to present a few extracts from many records which the Erie Steam Shovel company has received from quarries in many different sections. These records show that rock loading costs with steam shovel are averaging 25 to 65 per cent lower than the costs were when loading by hand. And the average saving in loading cost, in the different quarries considered, runs over 50 per cent.

For obvious reasons, it is better not to publish the names of quarries furnishing these figures but further details can be supplied to operators who are interested in going into this matter thoroughly, including the addresses of the quarry companies which made the records given here in part.

A typical report is that received from a quarry company in Connecticut, using ¾ cubic yard Erie shovels for loading blasted trap rock for crushing:

"With one ¾ cubic yard Erie shovel and 18 men we are getting the output which formerly required 40 to 50 men. Besides the big saving in our payroll we now have the assurance of a steady output every day."

This performance represents a saving in loading costs of 37½ to 50 per cent. The total cost per day of the Erie shovel is equal to the wages of 7 or 8 men, when all costs connected with the machine operation are included: interest on capital invested, and depreciation, wages of crew, coal, oil and supplies.

Another record made by a quarry in Ohio: "Our ¾ cubic yard Erie has loaded as many as 442 tons of lime rock, actual weight, per day of 9 hours, and can give us between 500 and 600 cubic yards in 10 hours. The best that we could average when loading stone by hand was 20 tons to

Working Under Difficult Loading Conditions.

the man, so the Erie shovel easily takes the place of 22 men."

When a machine which costs as much per day as the wages of 7 or 8 men does the work of 22 men there is a saving in loading cost of more than 60 per cent. Not every quarry can show such a saving in loading costs but a lot of them do; some records are even better. That these records are not remarkable or unusual will be noted from several of the following reports:

Another quarry in Connecticut; "One ¾ cubic yard Erie loads an average

Loading Cars Efficiently.

of 400 tons per day of 10 hours; the best day's work has been 500 tons."

A quarry in Kentucky: "One of our ¾ cubic yard "B" Eries is taking up a 12 foot ledge of rock in the bottom of our quarry and loading an average of 600 cubic yards in 10 hours." This is unusually good, about 25 to 50 per cent above the average performance on this work; it should be considered accordingly.

Here is another output, obtained by a Florida quarryman, which shows steam shovel possibilities but is about 70 per cent above reasonable average performance: "One of our ¾ cubic yard Eries loaded 21 cars, 850 tons of lime rock, into two-yard side dump cars in 10 hours, an average of 85 tons per hour." This record is given simply to show what can be done under favorable conditions.

The following record, made in a New Jersey quarry, is not above ordinary output: "Our ¾ cubic yard Erie shovel loads out 40 to 60 tons of very hard and rough trap rock per hour, when working in a fair average run of stone. When we encounter a great many stones that are too large for the crusher to handle, which must be swung out to the plug drills, this naturally cuts down production. However, when conditions are favorable we have no trouble loading 60 tons per hour."

Now, in event that some quarrymen may want to check for themselves the figures given here as the approximate cost of shovel operation—the wages of 7 or 8 men—let us set down a definite basis for figuring the shovel cost, which anyone can work out to fit his own case.

Local conditions, of course, govern the exact cost of labor, coal and supplies. For this reason, it would be of no value to set down any actual dollars-and-cents cost for steam-shovel operation, as the cost will vary in different parts of the country with work carried on under widely different conditions.

However, in every section the total daily cost of operating a ¾ cubic yard "B" Erie shovel is made of the following items:

Wages of a shovel operator, a fireman and a pitman; these vary in different sections but the total for the three men averages $15 to $20; coal, ½ to ¾ tons per day; incidental expenses such as oil, waste, supplies and renewals, $1.50 to $2 per day. Actual cost records have proved conclusively that the upkeep cost of an Erie shovel in rock loading runs less than a dollar a day, including all actual repairs and all consumed parts such as hoisting

¾-yd. Shovels in Large Quarry.

cable, grate bars and dipper teeth; depreciation on capital investment—this will run anywhere from $3 to $6 per day, depending on your accounting policy governing depreciation items. The company which makes depreciation allowances which are based on the actual useful life of each machine considered will be adequately covered by the lower figure, since there are ¾ cubic yard "B" Eries working in quarries today which are in good working order after 8 or 9 years of continual quarry service.

The Mobility of ¾-Yard Shovels a Valuable Asset in Quarry Work

Under present-day quarry practice, you cannot tell the financial rating of the operating company by the size of their steam shovels. Some of the largest quarry companies in the United States have standardized in the ¾ cubic yard size, operating fleets of 10 or more instead of fewer and larger units.

This preference is due to several reasons—first of all, because of the added assurance of steady output. It is safer to have two or three smaller loading units than one large one, when the smaller units are of standardized construction known to be fully as reliable in quarry service, or more so; second, the superior mobility of the ¾ cubic yard shovel—these machines can be quickly moved to any part of the quarry face that can be worked to best advantage or can be just quickly moved up on top to strip, since they take a 25 to 30 per cent grade without trouble under their own power.

An excellent example of quarry operation with ¾ cubic yard loading units is shown by the photograph, quarry of the Thomasville Stone and Lime company, Thomasville, Pa. This is a large lime quarry with a 60 foot face, where they shoot from 8 to 15 well drill holes, and load the stone with three ¾ cubic yard Erie shovels. Another of the same machines with locomotive crane attachment is used for the stripping.

When running full capacity the loading shovels average 400 tons of stone each in 10 hours; they can produce much more when the digging is easy.

Well Adapted to Stripping

Many records might be cited to illustrate the excellent suitability of the ¾ cubic yard shovel for stripping work. The following record covers the work of two ¾ cubic yard "B" Erie shovels in an Ohio quarry:

"The area just stripped is 50 feet wide and 200 feet long, and runs from 40 to 103 feet high, approximating 30,000 cubic yards of waste material. This material is of various formations, consisting of clay, light and heavy shale, and rock, the latter comprising about half of the total material to be removed. Most of the material is very heavy and hard to handle; we have been surprised to see our ¾ cubic yard Erie shovels getting away with it with such ease. Our best day's stripping was 566 cars, 1½ cubic yard capacity, loaded with one shovel while the other was being used for casting over."

Three Quarters Cubic Yard Shovels Reliable in Quarry Work with Very Low Upkeep Cost

When we recently gathered together a number of actual records made by ¾ cubic yard Erie shovels and published them in book form, there was considerable surprise at the low average of the daily upkeep figures. However, in all cases the cost had been carefully checked and re-checked; the figures which follow can be depended on.

One quarry in Maryland used a ¾ cubic yard "B" Erie for 4½ years, loading 316,000 cubic yards of rock, with a daily upkeep cost of a little less than 75 cents including both consumed parts, such as dipper teeth and actual repairs. This is 10 to 15 per cent below average cost,

Another ¾ cubic yard Erie, a veteran which was bought by a quarry company in Maine after four years of service for another owner, handled 250,000 cubic yards of rock, besides 75,000 cubic yards of gravel and other material, at an average maintenance cost of less than 55 cents a day, including, both the actual repairs and the consumed parts—an upkeep cost which is about 40 per cent below average.

The present stage of the steam shovel's development has set an entirely new standard for this useful tool; quarry men have found that the modern steam shovel is the most reliable of all machines around the plant. As the general manager of the Utica Hydraulic Cement company of Utica, Illinois, puts it: "Our ¾ cubic yard shovel has been in constant operation every day except Sunday and has never given us any trouble. It is on the job the coldest day in winter and the hottest day in summer yet repairs are practically nil."

In the last analysis, the question of steam shovel versus hand loading or the question of large steam shovel versus small steam shovel or any comparison of one particular type of shovel with another type all simmers down to actual performance records. "What are the facts recorded in actual service?" is the question that the quarryman should find the answer to —in fullest possible detail.

Application of Air Separation to the Pit and Quarry Industries

By W. A. KOREN, Raymond Brothers Impact Pulverizer Company, Chicago

In considering applications of air separation to the Pit and Quarry industry it will probably be best to divide the industry into three major groups and two minor ones. This division is being made on the basis of tonnage of materials produced.

The three major divisions would constitute the cement, gypsum and hydrated lime industries. The first minor division would cover a large number of the nonmetallic minerals used in smaller quantities as fillers in the paint, paper, rubber and building industries. The first group would include such materials as barytes, calcite, clays, under which heading would also be included bauxite, fullers earth and kaolin, magnesite, marble, the iron oxides such as yellow ochre and red iron oxide, shale, slate, talc and soapstone. The second minor group would cover the abrasive nonmetallic minerals such as feldspar, quartz, silica, tripoli and the like.

The above approximate divisions, based primarily upon the total tonnage of output, are considered simply with reference to the application of air separation and the importance of air separation in these industries.

Application to the Manufacture of Cement

Mills using air separation for classifying the ground material have been employed in the cement industry for a good many years. For a time this application proved unusually satisfactory in handling the raw materials, but only small size units were available, requiring a large number of these units for the average size of cement plant. On this account mills equipped with air separation have been replaced by the larger grinding units, such as tube mills and compeb mills. This condition may be reversed in the near future due to greater demand for a larger air separating unit which has now been developed and which will produce about twelve to fifteen tons per hour on the average grade of raw materials employed in making cement.

The most important application of air separation in cement plants is now for the grinding of coal. A great many mills are installed for this purpose. The big advantages are low horsepower requirements per ton, finer ground coal and a uniformity that can be absolutely depended upon at all times. This makes for more constant conditions in the burning of the coal, less coal per barrel of cement and practically no loss of combustible due to coarser particles, (produced by other methods of grinding) dropping out in the kiln before being burned.

Application to the Gypsum Industries

The first successful application to the gypsum industry of mills with air separation was made in 1910 or 1911. Prior to that time it was considered necessary only to grind the raw gypsum rock before calcining to a 60 or at the very highest an 80 mesh fineness. Most of this work was being done with the old burr stone. Then a demand came for a finer grind showing at least 95 per cent passing a 100 mesh. Mills with air separation were tried and found unusually satisfactory. Today, the application of air separation to the handling of gypsum products has become almost universal; nothing has been found which will replace it at an equal cost.

Application to the Manufacture of Hydrated Lime

Here, air separation has been used for a great many years; at the present time very few plants employ the old screen method. As in the handling of gypsum, the percentage of moisture in the material is one of the controlling factors. Any material with an appreciable amount of moisture will readily plug even the coarser screens. A material with considerable moisture will not seriously affect a mill equipped with air separation, because of the large openings inside of the mill and the fact that the air tends to pick up the moisture and prevent it from collecting at any particular point.

At the present time there is no doubt but what 90 per cent of the hydrated lime produced is handled by the air separation method.

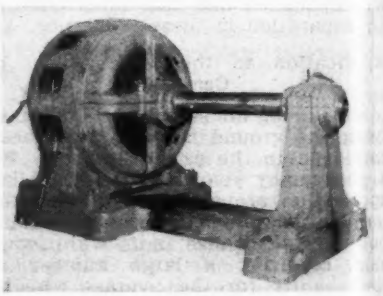
Electrification for Rock Quarries and Gravel Pits

By C. W. DRAKE, General Engineer,
Westinghouse Electric & Manufacturing Company

Gravel pits and rock quarries are not electrified to the same extent as many industries such as planning mills, machine shops, textile mills, etc., but this is due to two principle causes. First, location of the pits and second the requirements to be met. Quarries or pits are often located in remote places, perhaps along railroad lines, lakes or rivers, but often many miles from any source of electric power, and consequently electrification has been out of the question. However, the steadily increasing net work of transmission lines tying one city to another and often paralleling highways or railroads, is bringing electric power within the reach of most all kinds of manufacturing establishments, or users of power for any purpose. Where electric power has been available it is generally found that it has been used quite extensively for the more simple operations, such as the crushing, screening, conveying, pumping, etc., but that the shovels, excavators and perhaps the locomotives have been either of the steam or gasoline type. The development of electric motors and control apparatus for shovels, excavators and drag lines, which would stand the hard service and abuse to which this apparatus is subjected, has only been completed in the last few years. Reliability and continuity of service are paramount, but electric shovels are now on an equal basis with steam equipment, while their lower operating costs, maintenance and and depreciation, make them most economical where electric service is available in sufficient quantities and at a reasonable rate.

Depending on pit conditions, grades, distances to crushers or screens, the material may be taken from the shovels in numerous ways, such as by cable ways, serial, tramways or in cars drawn by mining type electric locomotives, inclined hoists, etc. Electricity can furnish the motive power in each case and the control of the cableways and hoists may be placed at any point giving best observation of the entire operation. Mining type locomotives are equipped with direct current motors on account of their superior characteristics for this service, and when such locomotives are used a synchronous converter or a synchronous motor generator set is required to convert a portion of the alternating current power to direct current power. The hoist and cableways are very satisfactorily operated by induction motors of the wound rotor type and speed control by resistance in the rotor is obtained either by a manually operated drum controller or by a master switch and magnetic type control, depending largely on the size and voltage of the motor used. Automatic controllers are preferable for most work, since they give better protection to the apparatus, are easy to operate and they stand up better under the severe starting and stopping conditions.

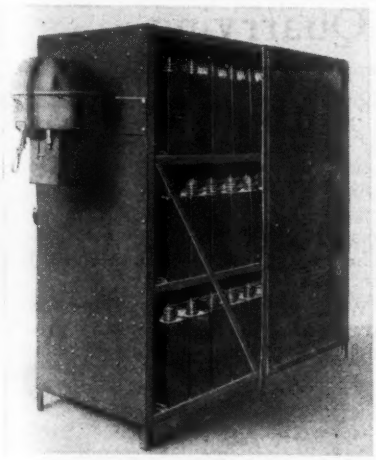
The reference above to a synchronous motor generator set for supplying direct current to the locomotives, brings up a point which should be kept in mind when laying a new plant or making additions to an old one and that is the question of power factor. Induction motors especially when



Motor Designed for Belted Service.

lightly loaded have a low power factor, and this causes excess losses in transmission lines, transformers, generating equipment, etc., so that power companies are rapidly introducing clauses in their rate schedules to take the power factor into consideration. Consequently, every opportunity should be taken to install apparatus having high power factor and the synchronous motor driving a D.C. generator in reality performs a double function,

that it supplies mechanical power to the generator and also corrects the power factor within the limit of its capacity. There are other good opportunities for synchronous motors in many places, namely on air compressors, and on centrifugal water pumps. Both of these machines usually operate continuously and so would correct the power factor during the working period of the plant. The air compressor with a direct connected



Westinghouse Static Condenser.

synchronous motor makes a most compact and efficient unit, while for belted machines it is possible to use either a belted type induction motor or a synchronous motor, depending on the need and valve of power factor improvement.

Unless the centrifugal pumps are of large capacity, requiring say 50 H.P. or over, the squirrel cage induction motor is best adapted and this is especially true if automatic starting and stopping is required from a float switch or regulator. If a large pump is required for continuous operation, as for instance in a washing plant, or if there is a large amount of drainage to take care of, a synchronous motor may often be used to good advantage. However, this question of power factor should be of secondary importance and the first requisite in each case is to obtain a drive of utmost reliability. If the introduction of the power factor question introduces too many complications, then it may be better to take care of the power factor in other ways, such as for instance by a synchronous condenser in the substation or by static condensers which in many plants make the best means of obtaining a desirable power factor.

Machinery in the crusher or screen building may be driven either by individual motors or in groups, depending on the size of the machines and the method of operation. As a rule a much better mechanical layout may be made by driving large machines individually and grouping small drives, such as screens and conveyors only when this can be done without the use of extensive shafting and belting. When several elevators, screens and conveyors must start in sequence and stop together, it is a comparatively simple matter to have the controllers interlocked to secure such operation. There are two types of induction motors available, namely the wound rotor and the squirrel cage rotor, and it is sometimes a question which type to use for the various drives. The squirrel cage motor on account of its freedom from collector rings, brushes and coil windings on the rotor, together with its more simple starter, has greater inherent reliability with a minimum amount of maintenance and should be use wherever possible. The wound rotor motor must be used where speed variation is required as on hoists and fans in some cases, and also on those constant speed drives where the load is greater than can be readily started by the squirrel cage motor. The dividing line between the two types of motors is not definite, but as a rule large crushers both of the gyratory and the jaw types, also group drives with considerable shafting and belting, should use wound rotor motors to secure satisfactory starting under all conditions. Of course, in case a crusher becomes jammed even a wound rotor motor will not start it until some of the rock has been removed, but it is not necessary to clear it as thoroughly as if a squirrel cage motor were used. Besides developing greater torque at starting a wound rotor motor draws considerably less starting current for the same torque than does the squirrel cage motor, and this is sometimes an item with the power company when only a few motors are installed in one location and one or two of these are of comparatively large size. Starters, both of the manual and automatic

types, are available for both kinds of motors. The automatic starter possesses numerous advantages for most of these applications as follows:

(1) They may be mounted in a separate room free from most of the dust and dirt.

(2) The push buttons or master switches in the plant take up little space and may be located on the driven machine at the most convenient place or in several places if desired.

(3) Operation of the controller and motor is entirely independent of the skill of the operator so that the machine is protected to a much greater extent than with manual control.

(4) Sequence interconnections are more easily obtained with automatic control and location at one place simplifies the wiring.

Cableways in Quarrying.

By JOHN SINCLAIR, Lidgerwood Manufacturing Co.

Quarry men do not seem to have grasped all the possibilities of cableways in quarry work. The cableway does all the work that could be performed by a travelling crane spanning the quarry in one direction and travelling the entire area of the quarry. Where the stone is to be delivered to a crusher, a head tower of a cableway is placed, and the tail tower travels on tracks covering the arc of a circle, the entire area of the quarry being covered by the cableway, and the output of the quarry is lifted at any point from the floor of the quarry, conveyed and delivered to the crusher, or to a storage pile, or placed in cars as required. Stone can be taken from any point of the quarry floor, and delivered at any point on the bank of the quarry.

Derricks placed at the edge of a quarry have a reach practically limited to 100 foot radius from the foot of the mast. Two derricks placed on opposite sides of a quarry can lift stone out of a pit 200 feet wide. In some cases this is ample. Where the stone lies in a wide and comparatively shallow bed, it is necessary to take stone from a greater surface area than can be covered by derricks. In such cases, derricks on the floor of the quarry load the stone onto cars which are pulled up an incline. This necessitates two handlings, with increased cost. A cableway moving radially around one of the towers could cover a quarry, spanning any distance up to between 1,500 to 1,800 feet, and even up to 2,000 feet. Such cableways have frequently been installed in quarries that could not be successfully worked by any other method.

In other cases quarries have been worked to such a depth that stone cannot be taken out by inclines, the depth of the quarry in comparison with the area of the opening calling for too great a slope for the incline. Again, we have a case where the cableway can be used to great advantage.

The cableway does not supersede the derricks, but it supplements them. Where the use of derricks stops, them the cableways step in.

Where stone is being taken out in large quantities the cableway presents another advantage. The head tower

At Palmetto Quarry, Columbia, S. C.

at the delivery end of the cableway can be placed far enough back from the edge of the pit so that railroad tracks can be run under the line of the cableway, and stone taken in skips from the quarry can be brought in and delivered directly to cars. Large stones are chained directly to the fall block of the cableway. Small stones, such as are to be fed to a crusher, are

Another View of the Cableway Installation at Palmetto Quarry.

loaded into skips which the cableway picks up and automatically dumps at any point desired. It will take stone from any depth of quarry.

Where an overburden of soil has to be removed, the cableway, operating a grab bucket, makes a very efficient long span excavator. It can be used for picking up drills, cars, or other machinery in any part of the quarry and placing them in new locations.

A fine example of the value of using a cableway in conjunction with derricks is that of the Palmetto Quarry Company of Columbia, S. C. This quarry is said to have been opened sixty years ago. At one time this quarry was operated by the State of South Carolina using convict labor. various concerns have operated this quarry, but it was never really successful until the present owners took it over in 1916, and their methods put it on a highly successful basis. At this time they were using two steel and one wooden derrick.

In 1922 they installed an electrically operated Lidgerwood cableway of the radially operating type. The head tower is placed at the crusher. The tail tower travels on an arc of 200 feet. The main cable is of 2½ inches diameter, Leschen locked wire rope, and the span is 500 feet between towers. This covers the entire part of the quarry now being worked. Due to the condition of the quarry the tower has to be moved practically each time a skip is picked up. The skip and load average about 9½ tons. These skips are being lifted a height of 120 feet, and then carried into a point above the hopper, and then dumped by the cableway operator in the engine house. This dumping is done by tilting the skip and without releasing any hooks or holding chains. One man handles the entire operation.

The present output of this quarry is 1,200 tons per day. The stone produced is a granite, and it is usually crushed for concrete and road work.

This plant is a splendid example of the use of the cableway in quarry work. By the addition of the cableway to the old outfit of derricks, they have increased their output materially, and it has made it possible to work a great area of this quarry that could not otherwise have been economically worked.

Buff Ridge Stone Company, Bedford, Ind. has been incorporated for $50,000; quarrying; directors, Robert Reed, William E. Powers, Robert L. Mellen.

Stripping Methods at Pit and Quarries[1]

By OLIVER BOWLES[2]

Stripping is a process in which every pit and quarry operator is interested. Even the few fortunate operators who are confronted with no overburden and may, therefore, view their neighbors' problems with complacency, see the wisdom of keeping informed on the subject, for extension of pits or excavation of new properties may at any time transfer them into the larger and less fortunate group of those who must conduct stripping operations.

Factors governing types of equipment.—Many different types of equipment are employed for the removal of overburden; each has its place, for stripping conditions are extremely variable. The nature of the equipment employed must be varied to suit conditions. The chief variable factors are composition, consistency and thickness of overburden, uniformity of the rock surface, nature and proximity of disposal area, and extent of operation. The purpose for which the product is used also has a definite bearing on the stripping process. For cement manufacture, clay is commonly added to a limestone; therefore, clay in pockets and seams need not be removed, for while mechanical control may be more difficult where such materials remain, the costly operation of cleaning out erosion cavities is avoided. On the other hand, rock for lime manufacture or for blast furnace flux must be free from siliceous impurities, and clay filled cavities constitute a serious problem in stripping.

Dr. Oliver Bowles

Advantageous conditions for various types of equipment.—In the following paragraphs the various types of equipment used in stripping operations are discussed briefly on the basis of the quarrying conditions under which each may be operated most successfully.

Hydraulic stripping. — Hydraulic stripping is the most economical method known, if conditions are favorable, but the governing factors are somewhat exacting. The following are the chief requirements for successful hydraulic work:

1. Ample water supply. On an average, about 10 tons of water are required for removal of each ton of stripped material. The same water may, however, be used repeatedly if sedimentation basins are provided where the water may be clarified through settlement of the solids.

2. A suitable disposal area. The most favorable conditions exist where the overburden may be washed directly into a ravine or other basin thus requiring no elevation of the material. Under such conditions one pump only is required, that which supplies a stream of water under pressure to the nozzle or monitor. If elevation is necessary, a dredging pump is required; this adds to the expense. The construction of dams or walls for an artificial settling basin may further add to the cost.

3. Cheap power. Power is the heaviest item of expense in hydraulic work; consequently cheap power, preferably electric power, is a necessary condition for economical stripping by this method.

4. Friable overburden. The overburden material should be of a type that can be washed down readily with

[1] Published by permission of the Director of the Bureau of Mines.

[2] Superintendent, Nonmetallic Minerals Experiment Station, Bureau of Mines, Department of the Interior, Rutgers College, New Brunswick, N. J.

Rugged Rock Surface Stripped Effectively by Hydraulic Method.

a stream of water. The presence of hardpan, or numerous heavy boulders, may render the hydraulic method unprofitable. The use of explosives in holes made with a soil auger has given very satisfactory results in a Missouri quarry, for by this means the overburden was broken up so that it was readily removed by the stream of water.

This stripping method is superior to all others for cleaning out depressions and seams on an uneven, eroded rock surface. A rough surface stripped by the hydraulic method is illustrated in Figure 1. The stream of water may be directed into all crevices and the debris washed out more effectively than by any other type of equipment.

Steam shovel.—The steam shovel is the type of equipment most generally employed for the removal of overburden in quantity. It gives very satisfactory service where a heavy thickness must be removed and where the underlying rock presents a smooth surface. The caterpillar shovel is a great time saver in moving from place to place. Like the tractor, it requires no trackage and has advantages over the tractor shovel in rapidity of movement and greater facility of travel over soft ground. The railroad type of shovel is in common use and gives good service though the time and labor required in laying track is a disadvantage. If the rock surface is dissected by erosion into cavities and seams, clean stripping can not be accomplished with the steam shovel; if such conditions prevail with a shallow overburden, the successful employment of such equipment is doubtful. Auto trucks, dump carts or cars on tracks are accessories required for removal of the stripped material to a disposal area.

Dragline excavator.—A dragline excavator operated from a derrick arm has some advantages over the steam shovel. The lateral motion of the derrick arm gives the excavator a wide range and great flexibility of movement. An uneven rock surface may be stripped more completely by this means than by a steam shovel, for it cleans out shallow depressions remarkably well though some hand work is required in the deeper cavities. The excavated material may be loaded on cars in the same manner in which a steam shovel is used. Figure 2 illustrates the use of such equipment in a Pennsylvania quarry where the rock surface is quite uneven.

Dragline scraper.—The simple form of dragline scraper may be used where a convenient dumping ground is available. Though some convenient devices for shifting the sheave attachment have been devised, in general this scraper lacks flexibility in lateral motion. Its operation over an inclined platform where the material is

dumped through a trap door into cars has been observed by the writer.

Clamshell bucket. — A clamshell bucket operated from a derrick arm or crane is used to a limited extent in moving soil overburden. Its chief application is in removing material from deep erosion cavities.

Tractor excavator.—A small tractor excavator widely used in road grading has been employed with success for removal of a thickness of 4 to 6 feet of clay overburden. The dipper slides back and forth on an arm 12 or 14 feet in length which may be raised and swung aside for dumping into cars or wagons. The excavator is so equipped that the dipper may be lowered into a pit, loading as it is lifted

Dragline Excavator Stripping Uneven Limstone Surface.

toward the surface. Such an adaptation permits it to be used in cleaning out cavities.

Pick and shovel.—The hand loading of overburden is laborious, slow and costly, which fact is generally recognized, but through conservatism, lack of capital, or limited extent of operation, it is still widely used. Conditions justifying the use of the pick and shovel may exist in some places. The quantity of overburden to be removed may be too small to justify the expense of purchasing mechanical equipment, but it is well for operators who use this argument to note that building contractors commonly find it economical to use a steam shovel for such small operations as excavating the basement for a dwelling house. If most of the overburden is contained in rough cavities that can not be easily reached by mechanical means or washed out with a hydraulic giant, resort may be had to the pick and shovel. Although the process is simple, the tools are low priced and the work is accomplished by the cheapest form of common labor, modern wages are too high to justify the method except under extraordinary circumstances. The pick and shovel are now used in hundreds of places where the employment of mechanical equipment would greatly reduce the stripping cost.

Stripping from deep erosion cavities.—Where the overburden rests on a smooth rock surface, stripping is simple and usually no obstacles are in the way of employing the most rapid and economical means now available. Where the rock surface is in the form of pinnacles and domes, with deep, clay-filled cavities between them, the problem of stripping becomes quite complex. The pick and shovel are commonly used and the soil relayed to the surface on a series of steps. This is a very slow and costly method; it is believed that a great saving could be accomplished by using clamshell buckets, dragline excavators, belt conveyors or bucket elevators.

Rock Washing.—Where a clean product is required, and difficulty is experienced in the removal of surface debris prior to quarrying, a washing plant may be employed to remove surplus impurities as a subsequent operation. Washing in a rotary screen or trommel is conducted very successfully at many quarries as well as at sand and gravel plants. Its wider use is urged. It is probable that such equipment would be justified only for a large output though small operators in close proximity might consolidate to establish a joint washing plant.

The Atlas Rock Company, Oakdale, Calif., recently incorporated for $150,000 as reported in our August issue, to take over the gravel plant built by the Modesto and Turlock Irrigation district, has purchased 160 acres of additional land at Oakdale which is underlaid with 12 to 15 feet of fine gravel and sand. A. C. McMillan, 903 Commercial & Saving Bldg., Stockton, Cal., is president of the company.

The Belvoir Stone and Supply Co., South Euclid Av., Cleveland, Ohio, has been incorporated for $140,000. Wm. T. Arnos, Sol. W. Wyman, M. C. Locher, Wm. M. Monroe, Charles C. Goldman.

The Storage of Material In the Pit and Quarry Industries

BY RICHARD K. MEADE, Consulting Engineer.

The storage of large quantities of material is one of the more important problems of the pit and quarry industries. The proposition here is somewhat complicated by the fact that the storage must be both cheap as regards first cost and economy of operation. In the manufacture of expensive commodities such as sugar, for instance, where the value of the product is eight or ten cents a pound, storage does not represent a very important part of the cost of making, handling and loading. With low price commodities, however, such as cement, agricultural ground limestone, crushed stone, ores and the like, even a small storage charge would represent quite a percentage of the total cost.

Relatively expensive products can be packed in bags and these latter handled several times, but with cheap products such as cement, hydrated lime, ground limestone, plaster and allied products, the stocking of material in bags would represent a charge of from 25 to 50 cents per ton, covering the expense of conveying the bags into the storage, piling them and then trucking them to the cars from the piles. In all of these industries, such an item of expense would often represent the difference between a profit and a loss in their manufacture.

In addition, the pit and quarry industries are usually "seasonal," where the demand for the product is much greater at one time of the year than at others; if the plants are to be operated uniformly throughout the year it is necessary to provide some form of cheap and efficient storage.

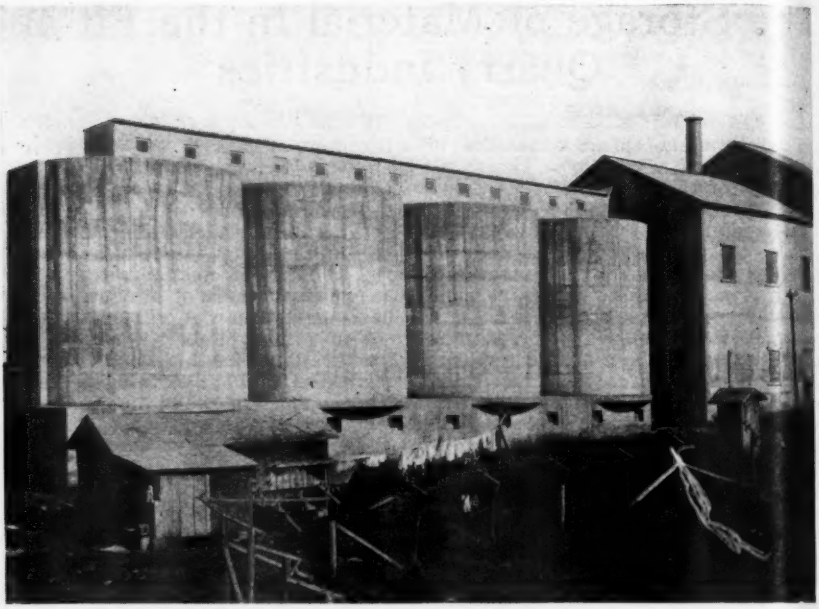
To handle material cheaply in and out of storage, this must be done in bulk. Aside from this the cost of bags themselves represents quite an item; if the product is stored in bags the value of these alone represents quite a sum of money ($2 to $3 a ton) upon which interest must be earned. In practically all of the pit and quarry industries, therefore, the storage problem is one of economically handling and storing a large quantity of material in bulk. The methods employed for conveying the material must be most efficient and the first cost of the storage itself must be, relatively speaking, low. The type of storage to be employed in any case will depend considerably on the material.

The writer has no intention of discussing all of the methods which may be employed for the storage of material in bulk but desires rather to call attention to some of the forms which he considers most appropriate.

The cement industry almost from its inception in this country had to solve the problem of storing the cement which was made during the winter. The first stock-houses consisted of long low frame or stone buildings divided into bins by means of wooden partitions. The partitions were employed so that each day's grinding might be kept separate. The bins usually held from 800 to 2,000 barrels each. They were arranged on each side of a central aisle or with an aisle on each side. The ends of the bins facing the aisles were stopped up by means of boards which could be removed; below the floor of the aisle ran a screw conveyor which carried the cement to the packing room. The screw conveyor was covered with a board or metal cover, except in front of the bins, where substantial gratings there three or four feet in length were used.

The cement was usually brought in from the grinding mills by an overhead screw conveyor and discharged into troughs or spouts which led the cement into the desired bin. The openings between the conveyor trough and the spouts were closed by iron slides and gates so that the cement could be placed in any bin desired.

When it was desired to draw the cement from any bin, the bottom plank was removed from the front of the bin and the cement allowed to run into the screw conveyor through the grating. When it ceased to flow by itself, a scrapper, which consisted of a flat iron plate about 6"x18", from the middle of which a long iron handle projected, was introduced. All the cement which could be pulled through the opening conveniently was drawn into the conveyor, after which the remainder of the boards were taken down and the rest of the cement was either drawn into the conveyor with



Concrete Silos Used for Lime Storage.

the scrapper else wheeled by barrows to the opening.

Considerable labor was required to draw the cement from the back of the bins to the screw conveyor in the aisle; to lessen this, additional conveyors were placed in the floor of the stock house at right angles to the main conveyor in the center. These cross conveyors were operated by means of a pair of gears, controlled by a clutch, and a long line of shafting on the side of the stock house, as shown in the illustration. Even with this device considerable labor was necessary to empty the bin.

A second type of stockhouse has distinct advantage over this first one. In this stockhouse, the conveyors are located in tunnels and the bins are provided with sloping floors, so that the cement will run out of the bins into the screw conveyors without the aid of manual labor. These stockhouses were much more expensive to build than those just described but were quite efficient so far as labor for emptying was concerned. They were much employed in the mills built ten or fifteen years ago.

The cement industry now, however, has adopted a form of stockhouse similar to grain elevators. Practically all of the newer cement plants are employing the silo type of stockhouse. This consists essentially of a series of tanks with arrangements for filling and emptying. Reinforced concrete has been found to be the best material for the construction of these silos.

One of the illustrations shows a modern silo storage for cement. This particular stockhouse as shown has a capacity of about 60,000 barrels. Since this picture was taken it has been increased by the addition of 8 more bins of somewhat larger diameter making a total capacity of 150,000 barrels.

With the silo stockhouse for cement, the ground cement is handled by means of screw conveyors and bucket elevators. At a few plants, belts are used instead of the screw conveyors but the latter is more generally employed. Where the material is granular or in the form of lumps, the belt conveyor would, of course, have to be used and the discharge point controlled by means of a movable tripper.

That portion of the silo type stockhouse which shows most variation in design is the arrangement of the bottom of the bins and the placing of the unloading conveyors. To some

extent this also affects the cost of the silo. The desire here is, of course, to have the bins self-emptying; this can be best obtained by making the bottoms of the bin in the form of a hopper. These silo stockhouses are often built by resting the silos on a reinforced concrete deck slab some 8 or 10 feet from the ground, the deck slab forming the bottom of the bin. This slab is in turn supported by concrete walls with spread footings carried down to a solid bearing to take the load. Numerous spouts lead from the bottom of the silos to the screw conveyors, which latter are located 10 to 15 feet below the deck slab. One of the illustrations shows such a stockhouse designed for hydrated lime.

This arrangement which the writer has used in stockhouses of the silo type which he has designed is shown in the line sketch. It is believed that a stockhouse of this design can be more completely emptied than any other. As the weight of material in the bins is carried directly on the ground, it is not necessary to build such heavy footings as those of the type in which the silos are supported on a deck slab. This type of stockhouse is, therefore, not only easier to empty but is considerably cheaper to build than the type of silo just mentioned.

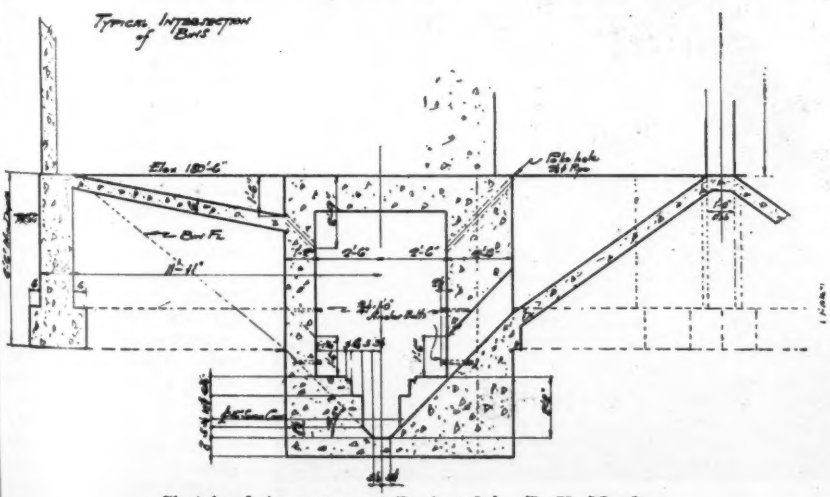
The silos are usually placed in parallel rows. This leaves a star-shaped bin between each four circular bins. It is general practice to use the bin so formed for storage, the outlets being so arranged that the material in this bin will flow to the conveyors placed under the silos.

The silo stockhouses are usually made quite high, as within certain limits for the same storage capacity the higher the bins are made the cheaper the silo. There is a point, however, in this connection which must be considered—the difficulty of operating very long bucket elevators. In the case of a very high storage, it may even be preferable to use two elevators instead of one long one. As a general rule, however, for storing cement and material of this character, these silo stockhouses are not often made higher than 90 feet; perhaps 70 to 80 feet is the most popular height.

The diameter of the bins is usually controlled by the needs of the individual user. For very large storage the bins are usually made from 25 to 35 feet in diameter. Thirty feet represents about the most economical size of bin so far as the cost of construction goes.

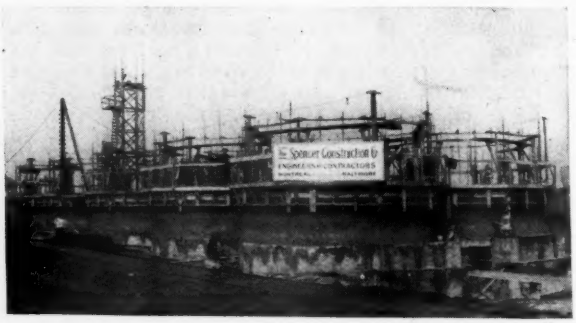
The stockhouses are practically, all of them, now made of reinforced concrete. This material is not only cheaper, but it does not require painting at frequent intervals as would be necessary with steel tanks. These concrete silos are now almost universally made by employing moving forms. In this method of construction the forms are moved as the concrete is poured.

The writer has just obtained two very interesting photographs showing

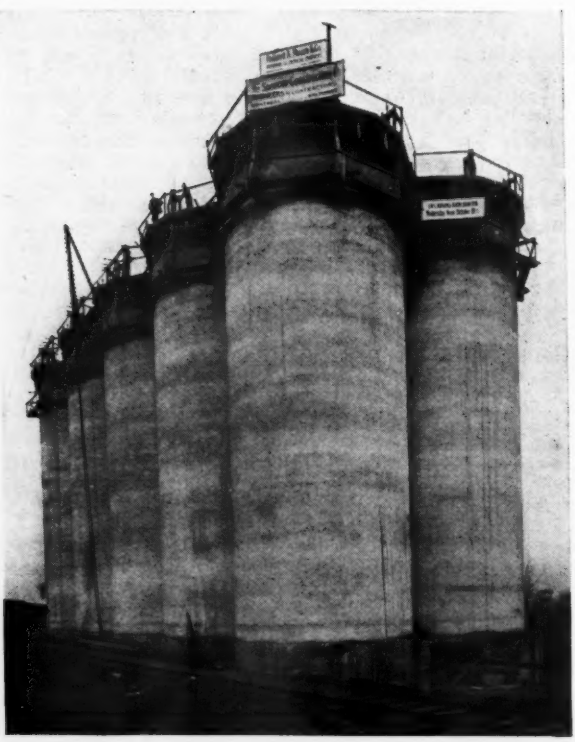


Sketch of Arrangement Designed by R. K. Meade.

the construction of such a silo stockhouse with the moving forms. These photographs are of the new stockhouse of the National Cement Company, Montreal-East, Quebec, Canada; they were taken eight days apart. They show the progress of the construction and also the forms which are used. The pouring of the concrete was started on October 10; the silos were completed on the 19th. This stockhouse was designed by the writer and built by the Spencer Construction Company of Baltimore, Md. The use of moving forms is not only found to be much cheaper for the construction of the silos, but they also give a much better looking job as the walls are perfectly smooth and uniform and do not present the broken appearance which is common where the forms are moved in sections and the pouring has to be interrupted.



Photograph Taken on Oct. 10.



Photograph Taken on Oct. 18.

Concrete silos are suitable for the storage of all material which will flow readily into and out of a bin but, of course, cannot be employed for storing material which sticks or packs. Among materials for which silo storages have been used may be mentioned cement, hydrated lime, ground and crushed lime, agricultural ground limestone, dead burned dolomite, plaster, ores, crushed minerals, dried clay, and the like.

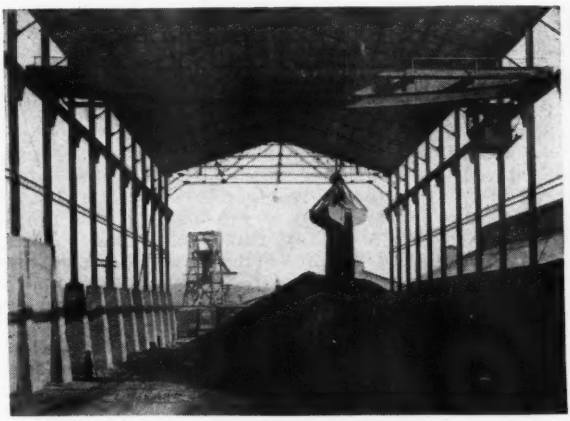
The form of bin construction shown in the line sketch cannot be very well employed where coarse material is stored, necessitating belts for the unloading operation. In this case, the deck slab construction will be better. The only modification which is necessary is to have spouts and gates of the proper size to take the large material.

The cost of building silo storages will, of course, depend on local conditions, design and other considerations, but by way of general information it may be said that they cost about 12 cents per cubic foot of storage exclusive of elevating and conveying equipment.

For the storage of damp, wet or sticky

material and also for the out-or-door storage of broken stone, cement, clinker, coal and ore there is nothing better than the grab bucket with some of the numerous arrangements which are made for handling.

All of the readers of Pit and Quarry are familiar with the locomotive crane equipped with a grab bucket which is now so extensively used for unloading and handling coal in and around power plants and industrial works. The possible use of this piece of equipment for the storage of crushed or broken material out of doors is quite evident. Generally the material is stored in windrows or long piles on each side of a track; when it is desired to reclaim from these piles the crane simply loads a standard coal car with the material and acting as its own shifter pushes the car to the point of use. For handling several hundred tons of coal per day it is hard to improve this arrangement, but when a thousand or more tons of material must be placed in storage and taken out in a day it is hardly adequate; some more rapid method of moving the bucket back and forth must be employed such as a traveling or revolving crane, a Gantry crane or a tall mast with a long boom.



Traveling Crane Handling Coal Storage.

It is probable that where space permits the traveling crane will give one of the most flexible arrangements for handling in and out of storage; it is also one which is adaptable to both indoor and outdoor work. In the manufacture of super-phosphate, a material is obtained for the storage of which silos and self-emptying bins can not be used because the material hardens and will not run out. This material is now generally handled and stored in modern phosphate plants by the use of the overhead crane and bucket.

These cranes are now being quite generally used for the storage of cement clinker and to some extent for the storage of crushed limestone. In the case of the clinker, the bucket handles it hot from the kilns; both indoor and outdoor storage is employed. For super-phosphate and materials of this character the storage is, of course, indoors. The traveling crane consists of a bridge or beam on which the trolley or bucket carrier operates; the bridge in turn travels on two rails which are supported either by two parallel walls or on two parallel rows of steel columns. Where bin storage is desired the walls of the bin carry the tracks for the bridge and the roof, if it is desired to protect the material from the weather.

The walls of the bin must, of course, be spread at the bottom or properly buttressed or otherwise supported to resist the outward thrust of the material. If desired the bin may be cut into various compartments to separate various grades of material by means of concrete cross partition walls and the like.

It will be found cheaper where it can be done to employ a steel frame to carry the bridge rather than the concrete wall. An accompanying illustration shows such a method of supporting.

Traveling cranes will unquestionably be employed much more generally for handling crushed stone and similar material than they have been in the past. Quite a few of the newer cement mills are making use of such a form of storage for limestone and clay. The type of stone and ore storage with belts overhead and tunnels underneath is not so efficient as the bridge crane. When stone or ore which has not been dried is placed in such storage there is always the chance that it may be too damp to flow out into the tunnels and

clay, or freezing and thawing may greatly aggravate this trouble. In the case of a large capacity the former type generally costs more to build and operate than the bridge crane.

For handling materials, bridge cranes are usually made with a capacity of from 5 to 15 tons (including the weight of the bucket), a hoisting speed of from 75 to 100 feet per minute, a bridge travel of 300 to 450 feet per minute, and a trolley travel of 100 to 150 feet per minute. The span may be quite wide if desired, but usually 100 feet are sufficient. Traveling cranes are rated by their lifting capacity but the amount of material such an apparatus will handle will depend quite as much on the hoisting speed and the rate of travel of the trolley and bridge as on the size of the bucket.

An illustration of a typical installation would be a 5-ton crane employing a 2-cubic-yard bucket, operating on a 40-foot trestle with a 100-foot span and a possible 200-foot travel per trip. Since the bucket would not always be full we could hardly count on an average load of more than 1½ cubic yards. Some time would be consumed in dropping and lifting the bucket. Sometimes the latter operation and usually the trolley travel can be undertaken simultaneously with the movement of the bridge. Assuming the bridge speed to be 300 feet per minute and the hoisting speed 100 feet per minute, hoisting the bucket the full 40 feet would require 24 seconds; the round trip for the bridge, or 400 feet, would consume an additional 80 seconds or 104 seconds in all. Allowing for time consumed in dropping the bucket for filling and for discharging its load, the trip would probably take 110 seconds or 32 trips; consequently the crane would handle 48 cubic yards of material per hour. If greater capacity than this is desired, since faster cranes are not usually made, manifestly a larger bucket and a more powerful crane must be employed.

Clam shell buckets are nearly always employed with these traveling cranes, although when digging hard material an orange peel bucket is often used.

The cost of a crane storage will depend on many things such as the span of the bridge, the length and height, the type of design and other factors. I have in mind one 5-ton crane open storage approximately 100 feet wide by 270 feet long, supported by a steel frame 35 feet high having a storage capacity of 550,000 cubic feet, which cost ready to operate about $30,000 or 5½ cents per cubic foot of storage. Another storage consisting of a reinforced concrete bin 100 feet by 250 feet with walls 20 feet high, equipped with a 5-ton bridge crane, cost $60,000 or 12 cents per cubic foot of storage capacity.

The crane can be operated by one man. The power consumed is about ¾ k.w.h. per ton of material handled. The latter depends largely on the length of the trip made by the bridge and on like factors. Repairs and supplies are light. The usual cost of handling is from 2 to 6 cents per ton of material handled, depending on the size of the bucket employed and other elements.

Where material such as coal and ore have to be handled from barges and stored, the Gantry crane with a cantilever extension over the dock to take care of unloading is now extensively used, the material being unloaded from the barge through hatchways by means of the bucket, and carried into storage. The Gantry crane is a modification of the bridge crane in which the bridge, instead of being carried on an overhead runway, is supported at the ends by legs which are mounted on wheels so that the crane may travel. These cranes have been made with spans as long as 500 feet from leg to leg. Gantry cranes are made with a bridge speed of 50 to 200 feet per minute. The type of crane is employed for a very large storage; some of the Gantry cranes employed for unloading and storing iron ore will handle 500 tons per hour.

A revolving crane equipped with a clam shell bucket is also often emmounted on wheels so that the crane should be mounted on a pillar of concrete and have a long boom. These cranes move more rapidly than the bridge cranes but are not adapted to such large storage. At the plant of the Bessemer Limestone and Cement Company such storage is employed, consisting of a Terry revolving crane equipped with a 100-foot boom and a 3 cubic yard bucket. This storage has a capacity of about 150,000 barrels of cement.

This type of crane is well adapted to a medium sized storage. A revolving crane equipped with a 3¼-yard bucket and a 70-foot boom will cost, set up and ready to operate, $15,000 to $17,500.

Multiple-Feed Lubrication with Grease

By THOMPSON G. DUBBS, Keystone Lubricating Company

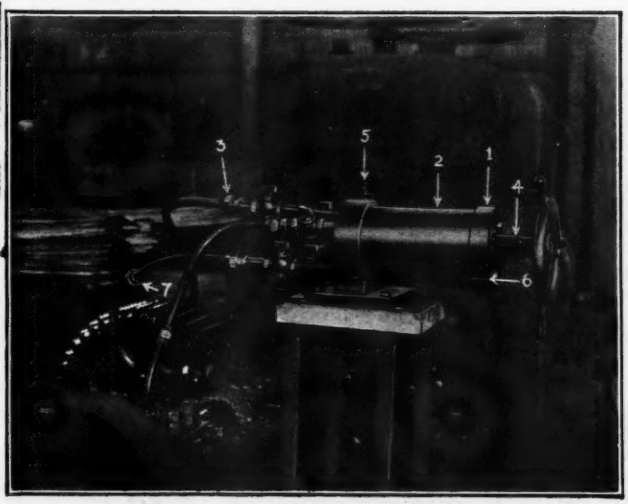
Under the pressure of present-day conditions, the demand for scientific lubrication is becoming more insistent. Not only is need for highly effective lubricants being felt but the need for effective methods of applying lubricants is likewise urgent.

A new method of applying lubricating grease, under high pressure, through pipeline connections to several bearings, has been developed by the Keystone Lubricating company of Philadelphia, Pa. The distribution is accomplished without risk to the operator and without waste of the lubricant. It is said that by this method of lubrication bearings which otherwise would be difficult of access on account of small clearances between working parts, heat, and other unfavorable conditions can be reached with ease. This insures the proper lubrication of bearings which under circumstances of inconvenient and hazardous locations would in many cases be neglected. The device by which lubricating grease is delivered simultaneously to several bearings is known as the Keystone manifold safety lubricator. It is shown in the accompanying illustration.

The manifold lubricator is attached directly to the machine which is to be lubricated, or mounted conveniently in the neighborhood thereof. The magazine, indicated by the numeral 1 in the cut, is threaded and screws into the cylinder, 2. The magazine holds eight pounds of grease. One complete turn of the hand-wheel forces four ounces of grease through the leads, 3. A gauge, 4 shows the amount of grease in the magazine. A vent cock, 5, allows air to pass into the magazine and break the vacuum that would otherwise be produced while the magazine is being withdrawn for a refilling. The magazine is removed with a spanner-wrench which fits into a slot, 6. The leads to the bearings are made of ½-inch iron pipe and art fitted with stop cocks for controlling the feeds. A union, 7, in each lead, permits quick disconnection at any time. As many as twenty-five bearings can be supplied with grease from a single lubrication.

In some cases the stop cocks can be permanently adjusted to allow a uniform flow of grease to all the bearings. This method, however, is not endorsed for universal use, because of the possibility of some of the bearings receiving a too copious supply of grease. It is recommended, therefore, that, when the time for a general greasing becomes due, all of the stop cocks but one be turned off. The plunger should then be screwed in until the particular bearing which is reached through the open stop cock is well supplied. The open stop cock should then be closed, the next one opened, and so on until all of the bearings have been lubricated.

This lubricator was designed with a view not only to economy, but to safety. It is intended to safeguard the lives and limbs of operators who are required to lubricate machinery in places where there is an element of risk. It is also intended to eliminate the risk of fires resulting from the



View of Lubricator Described Above.

saturation of floors and other woodwork with grease and oil. It is especially adapted to securing safety and economy in the lubrication of cranes. It is said to have been approved by compensation companies; these, it is asserted, will allow factory owners, using this lubricator, credit on their employes' liability insurance.

It is said that the importance of the manifold lubricator in the matter of economy has been well demonstrated in mills wherein this type of lubrication has been in operation for more than a year. It is said that in one mill the consumption of lubricating oil has amounted to more than five barrels a week, but that after a manifold safety lubricator had been installed, three barrels of grease sufficed to lubricate the mill for six months. It is asserted that in one instance the cost of lubrication for a period of six months was reduced approximately 80 per cent.

It is said that in cement, steel and paper mills and in laundries and foundries, or where else there is severe heat radiation, lubrication is best effected by means of grease. Greases having a melting point of approximately 350 degrees Fahrenheit are obtainable; these greases are designed for use under heavy pressures. The manifold system of applying these greases is offered to steel mills for use in hot and cold-neck lubrication of roll stacks.

In these installations the use of heavy flexible metallic tubing for the leads from the manifold to the machinery bearings is recommended. The importance of this will be readily understood by those familiar with piping. The fewer the number of bends in a line, the less will be the resistance of friction. It is claimed, however, that these lubricators have fed through a line of pipe extending more than sixty feet, containing eight right-angled elbows, the grease discharging freely at the outlet. There have been instances in practice where a single compression of the plunger has caused the grease to feed continuously and slowly for a period of twelve hours.

Baker Sand and Gravel Company Inc.) of Tuscaloosa, Ala.; J. E. Baker, G. K. Little and Mary Lou Baker, incorporators; capital $40,000, fully paid in; dealers in gravel and sand.

The Alabama company will soon have its new quarry at Leba, a few miles east of Gadsden, in shape for operation. A large new crusher and new machinery and new tipples have been put in.

The old quarry will be abandoned because the face of the rock being worked is 300 feet in sheer height and was becoming dangerous and difficult to work.

The company's Etawah mines will be put into operation soon after the big electric pump is delivered. It was purchased last May and delay in delivery has caused delay in operation of the mine.

As reported in our November issue, the Pratt Rock and Gravel Company of Folsom, Cal., is pushing work on its new plant. Equipment valued at $50,000 has already been purchased, consisting of screens, conveyors, locomotive and locomotive crane. Machine shops, blacksmith shop, pumping plant and oil storage tank will be constructed soon. Clarence F. Pratt, who is the president of the Pratt Building Material Company, owning sand washing plants at Sacramento, Marysville and Prattco, Monterey County, is also the president of the Pratt Rock and Gravel Company at Folsom.

The Amsden Lime Company, Amsden, Windsor Co., Vt., has been producing lime for more than a hundred years and is manufacturing that product today at the rate of 250 barrels a day. The company has enough lime rock on its 2,000 acres of property to keep up a steady business for more than a hundred years to come. The Amsden Lime Company is constructing a new kiln, which will make a total of four which they will have in operation within a short time and which will materially increase the output.

Ashland Limestone Co., Orange, Va., quarrying; $600,000; R. F. Hill, Josephine Hill, Orange, Va.; W. S. Hoge, Jr., Washington. (Corporation Service Co.

The Rack Sand and Gravel Company, Cincinnati, Ohio; capital $25,000. John M. Renner, Roy Manogue, Gordon Renner; Pascal St. Cyr, Carl J. Schuh.

Gasoline Shovel Applications

By H. S. STROUSE, Advertising Manager, Pawling & Harnischfeger Company.

The electric or gasoline shovel has found wide application in many quarries; the demand has increased by leaps and bounds during the last five years. This may be explained by their adaptibility to local conditions, economical operation and the absence of fuel and water-hauling troubles. These machines have proved that they have not only tremendous digging power and high output but that their operating costs are far below those of any type of power shovel. The principal advantages of these shovels may be summed up in the following:

1. Economical operation.
2. Powerful.
3. Speedy—large capacity.
4. Reliable.
5. Mobile.

Taking these points up in the order in which given we will elaborate.

One of the principal features of the gasoline or electric shovel is one-man operation. The fireman and watchman are eliminated; the saving in their wages is a large item.

Another money-saving feature of the gasoline or electric shovel is that it starts and stops instantly. There is no delay or extra working time required for bringing up steam or for banking fires when work is over. The expense stops when the engine stops.

Fuel and oil consumption are very low. The three-quarter yard machine uses from 1½ to 2½ gallons of gas or distillate per hour, depending upon the digging. Approximately one quart of lubricating oil is used during a 10-hour shift.

Fuel and water hauling expense is practically eliminated by the machine. This not only results in large saving but it also makes possible the operation of these machines in inaccessible places where it would be almost impossible to operate steam rigs successfully.

Another item that means larger profits from gasoline shovel operation is the absence of water troubles. There is no danger of freezing in cold weather, for the radiator of the gasoline machine may be quickly drained. No chemicals are needed for purification purposes and no time is lost for taking on water.

Another inherent advantage of the gasoline shovel is its tremendous digging power. Instead of three separate engines, one for swinging, another for crowding and a third for hoisting and travel, the machine has only one motor. The full power of this motor with inertia of its flywheel can be concentrated behind any motion—hoisting, swinging, travel or crowding. This is what gives the machine its ability to cut through rock and frozen earth or other hard substances and to move in the heaviest places or up steep grades.

A second reason for the power of the shovel is its real crowding motion. This feature is vital to the success of any power shovel, for upon it depends the ability of the dipper to bite into rocks or hard ground. The crowding motion on the machine is very simple in design and rugged in construction; its parts are amply proportioned to withstand heavy strains. It is powerful in action and requires practically no maintenance.

Speedy operation and large capacity are other important characteristics of the shovel. Yardage day in and day out in all classes of work is what the shovel user gets paid for and he naturally will select machines that do the work in the shortest time and at the lowest cost.

There are several reasons why the machine makes excellent yardage records. In the first place, the operations of hoisting, crowding and swinging can be performed simultaneously, which means minimum non-productive time. Ease of operation is another reason. The operator sits at his work and does not become as fatigued as when standing. He can therefore keep going steadily all day long. A third reason is the great digging power of the machine.

Depending upon conditions, the three-quarter yard machine (Type 206) will get out from 400 to 800 cubic yards per eight-hour shift. This high output combined with the low cost of operation gives a low cost per yard of earth moved.

Steady, consistent performance is the largest item in getting out big yardage; the machine was designed with this in mind. Every part of the machine is built with the idea of giving maximum service at low maintenance cost.

This is accomplished through the use of the very best materials that can

be obtained and through the employment of first-class workmanship throughout. As an example of high-grade construction, all gears are of steel with cut teeth; pinions are cut from solid forgings and all main shafts are of forged alloy steel turned and ground to micrometer size.

Machines (Models 206 and 208) are equipped with two travel speeds and can therefore travel over soft or rocky ground or up steep hills. Some shovels have climbed grades as steep as 30 per cent, which gives a good idea of their power and stability.

Steering is performed as easily as on a tractor by the operator from his seat, no man being required on the ground. The machine can be turned in twice its width.

The treads are very smooth and will not damage asphalt nor macadam streets.

Compressed Air in Pit and Quarry

By V. H. VAN DIVER, Ingersoll-Rand Company

Wherever materials that cannot be readily handled with a steam shovel are encountered in the pit or quarry, compressed air is an indispensable aid to the industry. It is reliable, it is flexible, and it is the most economical power medium that can be employed in its capacity. It is used to operate "Jackhammers," piston drills, drill steel sharpeners, plug drills, hoists and numerous pneumatic tools required for maintenance work.

"Jackhammers" for general quarry drilling are used for shot hole work, for block holing, for plug and feather work—any duty that requires a medium size hole of moderate depth.

The piston drill is primarily for deep hole work and channelling, but with the advent of the mounted hammer drill into the quarry field and the development of the X-70 Leyner Ingersoll drill, which manufacturer claims will drill 60 per cent more footage than a piston drill operated at same pressures, it has become obsolete and is rapidly being replaced.

To the quarryman, the X-70 has become a distinct asset. For years rock in many localities was quarried solely by the use of well drills or of reciprocating piston drills. The hammer drill has not only proved its ability to drill to such depths as 25 to 30 feet, which current methods require, but the ¼-70 has brought about a great change in quarry operations. It has increased production, cut costs, and it pleases the drill operator.

Leyner drill sharpeners are used for making and resharpening perfectly formed and accurately gauged bits of all sizes and types. Accurate gauging permits the employment of a minimum gauge variation between the successive steels and results in less rock to be cut and in drilling time saved.

Plug drills are utilized for plug and feather work, pop hole drilling, trimming and similar work requiring holes up to 6 inches in depth and 1 inch or less in diameter.

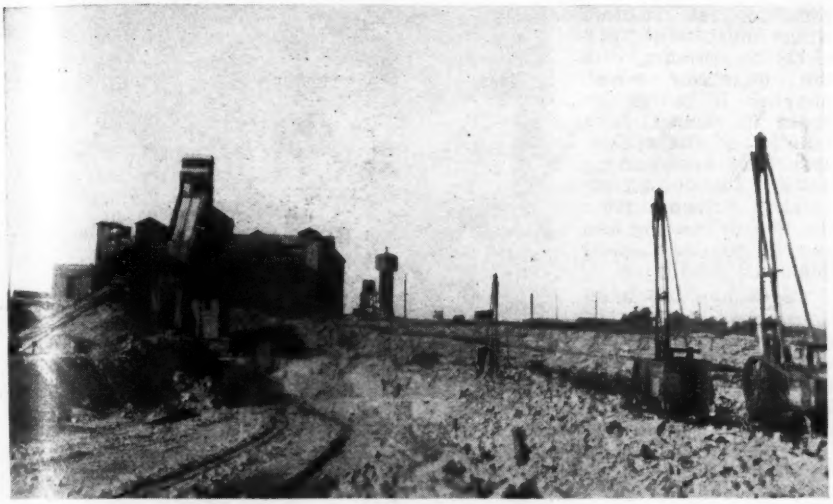
"Little Tugger" Hoists are portable and find extensive application around the quarry for such work as switching and hauling cars, hoisting drills, steel and supplies, and similar duties where the load is a light one.

The application of pneumatic tools to quarry work is principally in the repair shop. Portable drills, riveting hammers, grinders and paint sprays speed up repairs and reduce maintenance costs.

Bibliography of Magnesian Cements

A bibliography of magnesian cements, by G. H. West, R. L. Sebastian and W. A. Darrow has just been issued by the Department of the Interior, through the Bureau of Mines. This bibliography was compiled in the course of research work by the Bureau of Mines on the utilization of the magnesites in the West. The results of the research will appear later as a bulletin of the bureau. The present bibliography cites 211 references relating to analytical methods; physical and chemical properties of magnesium and calcium compounds; calcining operations and manufacturing of magnesium oxide or hydroxide; constitution of magnesium oxychloride cements; practical preparation of cements; tests and specifications; magnesite statistics, etc. Serial 2534, "Bibliography of magnesium cements," may be obtained from the Department of the Interior, Bureau of Mines, Washington, D. C.

Boonville Sand Corp., Utica, N. Y. has increased its capital from $10,000 to $100,000.



Electric Driven Blast Hole Drills in Large Quarry.

Electricity In The Quarry

By R. H. ROGERS, Power and Mining Department, General Electric Company,

Electricity, once a laboratory plaything has advanced to the giant workman that it is today, not by refining the rough industrial world to its own once limited standard but by steeling itself successively and successfully against all elements of weakness as they were developed in the rough and tumble fight for supremacy in the field. Motors of standard design, "right off the shelf," brace up to the "toughest" jobs and complete them, year in and year out. Quarries may be listed among the "tough ones" that electric motors have well in hand.

A word as to the details of power, its distribution, the motors, their control and some characteristic motor applications may be useful in quarry work planning.

Alternating current is almost exclusively used because the adjustable speed characteristic of direct current motors is not needed. The cycles and phases will depend upon the power that can be purchased or arranged for as a stand-by service. When there is no likelihood of purchasing power, a private plant should be chosen to deliver 60 cycles 3 phase current to the motors at 440 or 550 volts. If the area covered is small the generators may be of the same voltage, but if the operations are spread over a large area or are in several sections, at least 2,300 volts should be used for generation and transmission. Transformers in the neighborhood of a group of motors step the voltage down to the motor rating. This precedure is to save copper in the lines. When power is purchased it will probably be delivered on the site, at 2,300 volts or higher, to a bank of transformers where the quarry connects to the low voltage side for service.

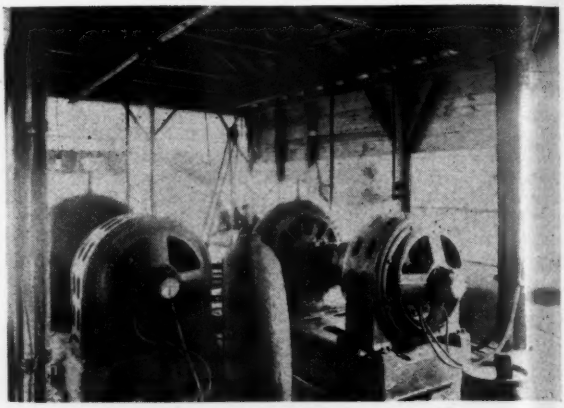
Alternating current motors are of three types:

(a) Squirrel cage rotor motors, with fairly high starting torque, pull a heavy starting current from the line and operate at practically constant speed (3 per cent variation no load to full load). They are extremely simple; the rotating members has no insulation and no moving contacts. This type is most generally used on quarry machinery; (b) Wound rotor motors which have an insulated set of windings on the rotor connected to rings and through brushes to the power and control system; these motors have a very high starting characteristic; do not pull excessive currents on starting and may be operated at reduced speeds by means of resistance introduced in the rotor circuit; the speed is affected by the load; (c)

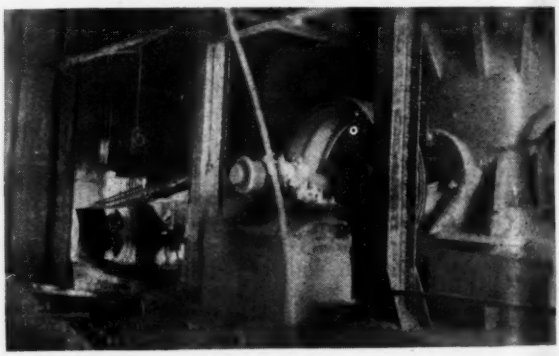
Synchronous motors which must rotate precisely in rhythm with the generator which supplies it power because its speed is a function of the cycles; they have low starting power; do not pull excessive currents from the line in starting and run at constant speed under all conditions.

They have the additional characteristic of correcting power factor which materially affects rates if power is purchased, and horse power that can be delivered to a group of motors by a given generating plant and distributing system.

For instance, a 700 hp. group of squirrel cage and wound rotor motors with .7 power factor (which may be expected in quarry service) takes as much fuel and heats generators and cables as much as an 850 hp. group in which there is a 240 hp. synchronous motor. Thus 150 horsepower otherwise wasted is put to useful work.



A Good Electrical Installation in A Quarry



250 Horsepower Motor Driving Gyratory Crusher

Drills are driven by squirrel cage motors whether rotating augers, mechanical drive chisels or pulsating air chisels. The starting load is light; sizes are such that there is no undue line disturbance in starting, and the simple construction and control make them ideal for this service. Jack hammer drills driven from air compressors and air compressors in general are driven by wound rotor motors because of the heavy starting duty. They are generally fairly large units which justifies their use from the line disturbance standpoint in starting.

Centrifugal pumps are almost invariably driven by squirrel cage motors. Low starting load and infrequent starting are characteristic of this application. Reciprocating pumps require wound rotor motors to meet the heavy starting duty and to give reduced speed operation at times.

Derricks are invariably a wound rotor motor field because of the very frequent starting and heavy starting duty in hoisting. The solenoid load brake gives fine control of lowering speeds; stopping and holding is secured by the usual solenoid brake.

Crushers, whether gyratory, hammer, jaw or roll type, may be driven by squirrel cage motors as the starting duty is light unless jammed, in which case even a wound rotor motor would be unable to effect a start. Dumping or digging out is usually resorted to in case of a jam.

Screens are also squirrel cage motor driven either individually or in groups. A line shaft drive handling crushers, bucket elevators and screens together is a common thing.

The synchronous motor may be used on such a line shaft or on a large continuously operated centrifugal pump. Their most frequent application is on air compressors which require large motors, and have low starting load when equipped with an

unloading valve. They require direct current excitation for the fields but this is usually obtained by having a small direct current generator mounted directly on the shaft.

Squirrel cage motors are controlled by simple compensators which provide all necessary overload and under voltage protection. They are enclosed and suitable for quarry service. Synchronous motors are also controlled by compensators with the addition of field discharge switch and resistance. Wound rotor motors require two units: The first, a line switch; the other, a variable resistance which is used in starting or to effect reduced speed operation.

The prime reasons for the use of electricity in quarries are: (a) Elimination of long lines of steam or air piping with attendant lines and cost of maintenance and moving; (b) Thoroughly flexible means of distributing power to necessarily shifting locations; (c) Assurance of continuity of service at a lower cost than can be obtained by any other means.

Improved Slate Quarrying Methods

Waste slate is a problem of outstanding importance in the slate industry, for a very large proportion of all slate quarried is thrown on the waste heap, states Dr. Oliver Bowles, mineral technologist, Department of the Interior, in Serial 2532, recently issued by the Bureau of Mines.

While many uses for waste slate have been found, the demand calls for merely a fraction of the present supply of unused material. If the slate industry is to increase in prosperity, the producer's energy must be directed toward the development of ways and means of reducing waste to the lowest possible point.

A process of drilling and broaching as a substitute for channeling or blasting is now being tried out in certain Pennsylvania slate quarries in an effort to reduce the waste due to shattering. The cutting rate is about half as fast by the new method as by the old, but so little damage is inflicted on the rock that the proportion of usable slate is greatly increased. Also the investment cost and maintenance expense are lower for drilling than for channeling. The new mode of operation has scarcely passed the experimental stage, but it seems probable that with improvements that are the outgrowth of experience, the new method will become more and more successful.

The drilling and broaching process is described in detail in Serial 2532, copies of which may be obtained from the Department of the Interior, Bureau of Mines, Washington, D. C.

Utilization of Waste Limestone at Lime Plants

Thousands of tons of pure limestone in sizes under 4-inch are either entirely wasted at many lime plants or are sold for uses that bring a very small return to the producer. The Department of the Interior, through the Bureau of Mines, has undertaken a study of possible methods of utilizing such material, the study relating particularly to methods of burning it into lime. Preliminary work has been done at the non-metallic minerals station of the Bureau of Mines, New Brunswick, N. J., on present uses of waste limestone and on the success with which the rotary kiln is used with fine materials. Arrangements were made for field investigations at several Pennsylvania plants.

Catalog on Haiss Loaders

Catalog 523 of the George Haiss Manufacturing Co., covering the line of Haiss truck loaders, is an attractive publication that will undoubtedly increase the sale of the equipment it describes. The booklet is made up of descriptions of the various machines in the Haiss line with illustrations of many of these in actual operation. Considerable attention has been paid throughout the text to the subject of operating costs and many examples based on actual occurrences are quoted to show the advantages of Haiss machine loading over hand methods. These figures indicate how loading costs can be reduced from 54 cents to 18 cents per cubic yard.

After the general description, an amount of space is given in the book to description of various features peculiar to the Haiss machines. These features are illustrated by halftone and line cuts.

A copy of Catalog 523 may be secured by writing to the George Haiss Manufacturing Company, Inc., 141st Street and Park Avenue, New York City.

Progress in Rock Drilling

By H. J. BRADLEY, District Manager, Chicago Pneumatic Tool Company

The development of rock drills in the last decade has been marked by achievement similar to and along the same lines as the balance of modern machinery. The trend of progress is toward minimizing the initial cost, maintenance and weight. The work of the old type Corliss pumps is now handled by multi-stage centrifugal pumps, which occupy about one-fifth the floor space of the old type pump.

This fact is particularly true in the manufacture of rock drills for quarry work, from the old 3¼-inch slogger drill weighing approximately 400 pounds to the piston drills of lighter weight, finally the advent of the hammer type drill. This progress has been marked by reducing the actual weight of rock drills without sacrificing efficiency, until now we find quarry and mining drills in operation weighing less than 40 pounds. As an example, the CP-5 drifter or sinker, a machine weighing 112 pounds of the hammer type manufactured by the Chicago Pneumatic Tool Company. This light drill has been tested upon a Paynter testing machine; with an air pressure of 90 pounds it delivers a 68 foot pound blow at approximately 2,200 blows per minute, consuming less than 90 cubic feet of air per minute.

Let us compare this with the older type of piston drill. To obtain the same efficiency as demonstrated by this particular hammer drill, it would be necessary to employ the use of at least a 3¼-inch piston drill striking only a 52 foot pound blow and consuming 25 per cent more air than its lighter competitor.

Atlas Quarry Cars

The constant demand for extra heavy serviceable stone or gravel dump cars has been met by Atlas Car & Manufacturing Company, Cleveland, Ohio, which has designed and patented a car meeting with favor among rock product engineers and highly praised by quarry operators who have them in use.

The hopper of the car rests on a suitable structural bed; it is provided with pivot projections secured on the ends and extending downward therefrom, engaging pivot members which are angular on the bottom and have flanges extending up which engage the pivot projections inside and toward the body, thereby holding the body against endwise movement upon the frame and also forming means by which the body may be swung up to dump the load.

On each side of the hopper are suitable rings or hooks which may be engaged by any suitable air or electric hoist. When the hopper is to be tilted, hoisting mechanism is connected to the link or hooks on the side opposite to which the hopper is to be dumped, the body turning on the pivots engages in the angle of pivot members on the side corresponding to the one upon which the body is to be dumped.

New Two-Piece Chain

The Anthracite Chain Company of Hazleton, Pa., produces a two-piece chain suitable for elevator conveyors and in other places around pit and quarry operations where conveyor and power transmission chain is used.

The chain is suitable for operation on any standard sprocket from one inch pitch up. It has no loose pins, the center links or pins being made up of one forging. The bearing surface of the pins and side links are thus reinforced and the diameter of the pins increased. The parts are made from high carbon drop forged steel in eight different sizes from 3-inch to 9-inch heavy.

The assembling of the chain permits the setting of pins and side links in a way that forms a semi-ball and socket joint which prevents side play and eliminates the possibility of climbing the socket. When in service only half of the pitch is required for slack to take the chain apart. Back lash is prevented by contact between the stops and the back of the pins with the extreme ends of the side links.

The chain carries the approval of the Industrial Board of the Pennsylvania department of labor and industry.

KENNEDY BALL BEARING GEARLESS CRUSHERS

WHY THEY LEAD

1—They are noiseless and run like watches.

2—50% greater capacity for same power.

3—Practically no wear on anything but head and concaves.

4—Short shaft and saving in head room with packed dust collars.

5—Shaft reinforced with self-locking head so that it cannot break where 90% of shafts have broken.

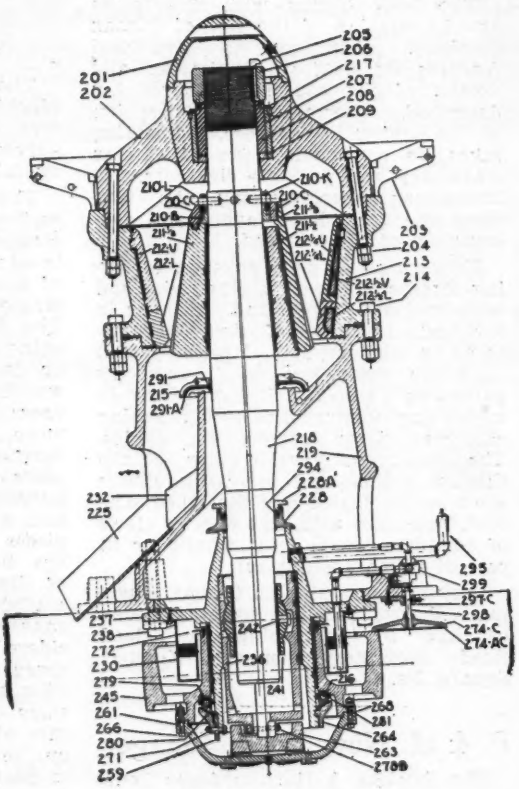
6—Can be driven right, left, or standard, as sent from shop.

7—Eccentric is turned by flexible coupling attached to pulley, which prevents side thrust and heating, as in geared crushers.

8—Ball and socket eccentric, self-aligning, eliminating friction and heating. Runs for years without attention.

9—Positive circulating oil system through filter and cut geared oil pump.

10—Made in our own shop by experts, trained for the job.



11—It is a crusher with the trouble left out. See it in operation, and you are unfit to listen to any geared crusher salesman. In fact, if you are near one of his machines, you can't hear him, if you were so inclined.

12—Our fine crusher does the work of 4 geared crushers.

Send for catalogue and tell us what your problems are, and one of our experts will call on you without obligation on your part.

KENNEDY VAN SAUN MFG. & ENGR. CORP.

50 Church St. **NEW YORK**

CIE. DES. ENTREPRISES INDUSTRIELLES, PARIS

Climax Machinery Catalog

Climax rock crushers, elevators, screens, conveyors, elevator feeders, bin gates and chutes are thoroughly described in a recent catalog of the American Road Machinery Company, Inc., of Marathon, N. Y., of which the Good Roads Machinery Company of Kennett Square, Pa., is general agent.

The book begins with description and illustration of the line of Climax crushers. Advantageous structural features are set forth in the text and details of the equipment thoroughly described. After a five-page exposition on the subject of crushers, the catalog takes up a consideration of Climax stationary and portable elevators. Illustrations accompanying the text show the gear drive layout and construction of the foot end.

Following this is a page on revolving screens illustrating types with and without sand jackets and outlining in the text the range of sizes manufactured by the company. A page devoted to pump equipment is followed by pages on Climax belt conveyors in which are illustrated idlers, troughing carriers, return carriers and guides. The Climax box type bin gates and the Climax hopper and revolving chutes are also illustrated and described. The book concludes with a number of views of complete plants built wholly or in part of Climax equipment.

Copy of the catalog on Climax crushing and road building machinery may be had by addressing the Good Roads Machinery Company, Kennett Square, Pa.

P. & H. New York Manager

The Pawling & Harnischfeger Company of Milwaukee, Wisconsin, manufacturers of excavators, cranes and machine tools, have recently appointed Mr. R. P. McCormick as their Eastern sales manager with headquarters at 50 Church street, New York City, and 605 Stephen Girard Bldg., Philadelphia.

Walter L. Taylor has purchased the interest of John H. Weddle in the Montebello Sand and Gravel Co., Montebello, Calif., which he and Mr. Weddle have been operating as partners. The business will be continued with Mr. Taylor as sole owner.

Joins Northwest Company

G. G. Kingsbury, advertising manager of the Thew Shovel Company, Lorain, O., has resigned to join the sales department of the Northwest Engineering Company, Chicago, manufacturers of power shovels. H. E. Billington, vice-president in charge of sales, is at present in charge of advertising for the Thew company.

New Acme Literature

The new catalog of the Acme Road Machinery Company, Inc., of Frankfort, N. Y., affords a fairly complete survey of the line of equipment built by this company.

The design of Acme crushers is described by text and illustrations accompanied by line sketches and tabulated specifications. Interesting pieces of equipment in this section are the single and double tailings crushers. The double tailings crusher is a machine that may be operated as a single or double unit. Its very appearance would make it interesting to most users of jaw crushers, for it is nothing more than two crushers in one. Pages devoted to the illustration of various parts of the crushers accomplish this purpose very thoroughly. Elevators and screens are treated next. Typical pieces of equipment of these two kinds are shown and a number of tables of dimensions, weights, etc., are included. Belt conveyors and feeding conveyors are the next topics considered. After this is an amount of space devoted to portable equipment. This is succeeded by data and illustrations on the steel and wood quarry cars of various designs manufactured by the company and by space devoted to portable gas power plants, to the Acme pulverizer and the Acme belt hoist.

Copy of the latest catalog of the Acme Machinery Company, Inc., may be had by addressing the company at Frankfort, N. Y.

Whitehouse Trap Rock Company, New Brunswick, N. J.; capital $50,000; incorporators: Arthur C. Ellison, 367 Somerset St., New Brunswick; Gilbert H. Van Note, 459 High St., Newark; Helen C. Barnwell, 21 South Fourth Avenue, Highland Park, to engage in the trap rock and other allied businesses.